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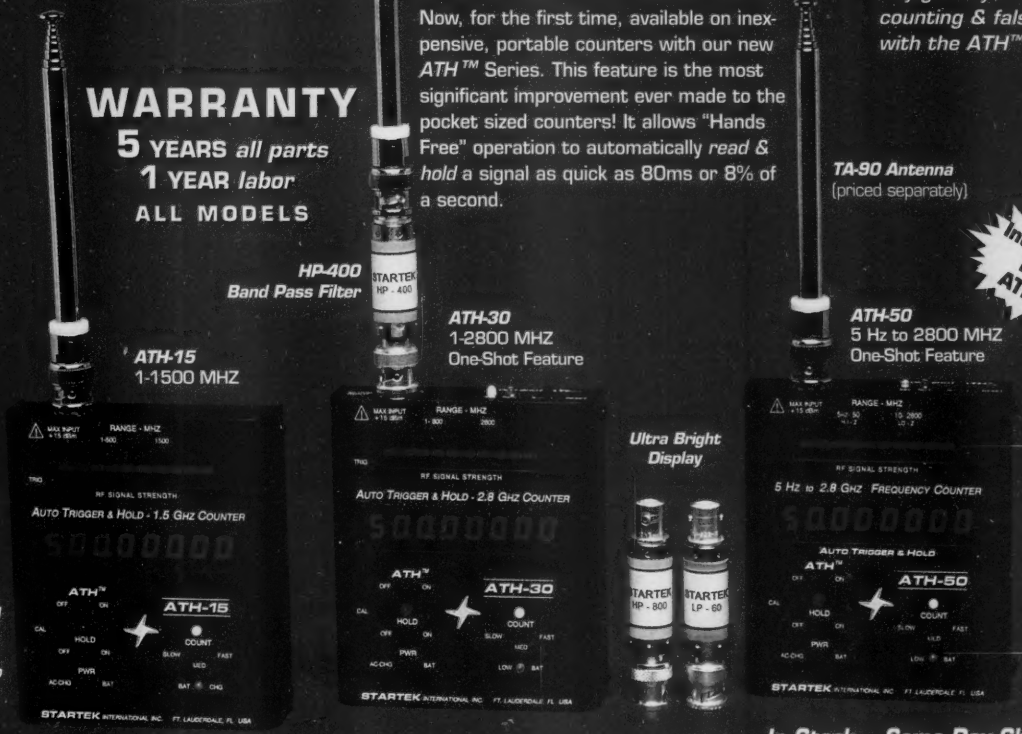
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73 Amateur Radio Today

November 1993
Issue #398

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THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

ASSOCIATE PUBLISHER/EDITOR
David Cassidy N1GPH

MANAGING EDITOR
Hope Currier

SENIOR/TECHNICAL EDITOR
Charles Warrington WA1RZW

EDITORIAL ASSOCIATES
Sue Jewell
Joyce Sawtelle

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
David Cowhig WA1LBP
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Arnie Johnson N1BAC
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
ADVERTISING COORDINATOR
Judy Walker
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

GRAPHIC DESIGN
Suzanne Self

GRAPHIC SERVICES
FilmWorks, Inc.
Hancock NH

TYPESETTING
Linda Drew

CIRCULATION MANAGER
Harvey Chandler
To subscribe: 1-800-289-0388

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
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Foreign Subscribers
1-609-461-8432

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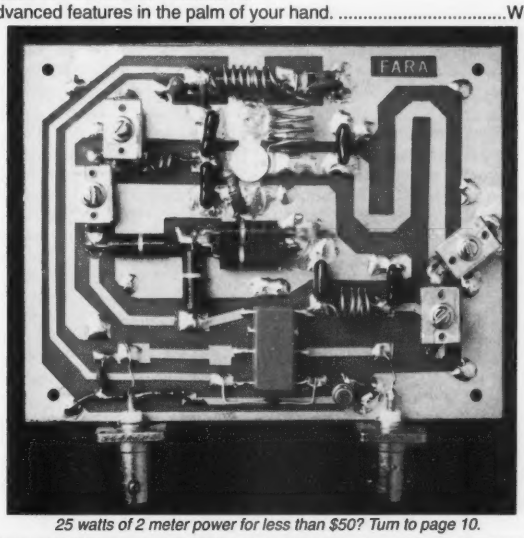

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On the cover: Senior Editor Charlie Warrington WA1RZW takes his 2 meter HT hiking in New Hampshire's autumn woods. Photo by David Cassidy N1GPH.

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Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

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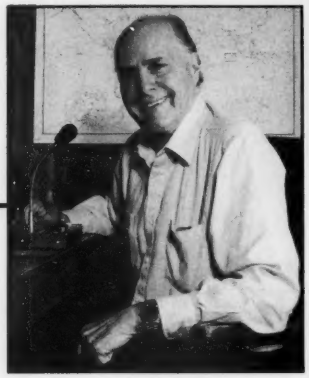
NEVER SAY DIE

Wayne Green W2NSD/1



Amateur Radio Frontiers

There are still plenty of frontiers for the adventurous ham to explore and pioneer. Everything hasn't been invented, by a long shot. Indeed, there are tons of articles I'd love to see published in *73*, if only you'd write 'em.

For instance, I've seen pittiful little in recent years on slow-scan developments. We need to (a) digitize slow-scan so we can send some really detailed full-color pictures, and (b) use modern compression technology to keep the bandwidth down. When's the last time you saw any articles on things like this? What do you need to get your mind working and your fingers busy? With the progress we've had in slow-scan technology in the last few years, any interested ham with totally zero technical knowledge and a will could have come from zero to being the top expert in the field. All it takes is some interest and the determination to overcome obstacles.

When I first got interested in RTTY I knew zilch. But I was fascinated, so I read everything I could find . . . which wasn't much. I hounded the only expert in the field I knew, John Williams W2BFD. I built my own equipment using John's designs, a Model 12 Teletype machine he got for me, and got on the air. Wow, what fun! This was when I first learned about digitally encoding information and the ability of frequency-shift keying to get through interference far better than off-on (CW) keying.

Teleytype used a five-bit code, which meant that there were just 32 possible combinations of zeroes and ones, or marks and spaces, as we called them. This is why telegrams and news Teletypes all used to print in upper-case letters. We didn't have any lower case. We even had to shift to handle numbers and punctuation. This is why ASCII code, which all computers use today, has eight bits. This allows 256 combinations of zeroes and ones, giving us far more flexibility.

When I couldn't get anyone to put out a newsletter to help us pioneers learn more about RTTY I finally gave up and did it myself. Indeed, that's what got me into the publishing business. I called it *Amateur Radio Frontiers*, and that was back in 1951. I wrote it, drafted the schematics, sold the advertising, took the photos, set the type, pasted it up, handled the subscriptions . . . everything. It was incredibly valuable experience, and it changed my life.

Digital Compression Systems

With modern microcomputers it's relatively easy to digitize pictures. You can feed 'em into your computer from a home video camera or a scanner. But a decent picture can take a megabyte or more of memory, which is why we haven't been seeing much in the way of live video digitized yet. At 30 megabytes per second, that eats up a whale of a lot of memory in a hurry, no matter what you're using for storage.

So, the engineers have been working to compress the data, using various approaches (algorithms). The International Standards Organization's Joint Photographic Experts Group (JPEG) uses a discrete cosine transform which compresses files by 90-95%, giving us ratios of 10:1 to 20:1. Iterated Systems of Norcross, GA, went the fractal route and has been able to compress data around 75:1.

Fractals? If you haven't messed with these babies you've missed a whole new world of math and beauty. IBM's Mandelbrot got interested in chaos theory a decade ago and discovered that seemingly chaotic systems produced similar patterns when plotted. He called the resulting patterns fractals. Computer owners with color displays can generate these beautiful patterns. If you aren't familiar with fractals and chaos theory, you're letting the real world get away from you. As hams, you're supposed to be up on science and electronics. You're not flying under false colors, are you?

So, let's see some articles on digitized slow-scan pictures. Let's see some articles on the theory and practice of compression techniques. And, let's see some protocols for digital slow-scan.

If we can at least send our American standard video picture quality (NTSC) by digital slow-scan, then we can start working on ways to move to high definition slow-scan. One step at a time. More and more of us are buying high definition color monitors for our computers, so we've got the makings of some wonderful slow-scan pictures.

You may not be an expert on digital video now, but by next year are you going to be even further behind? Or will you be one of the people writing the articles? When I got started publishing my RTTY newsletter it didn't take long before I knew what I was doing. A few years later I published the first book on ham RTTY. In the meanwhile my columns in *CQ* helped get thousands of hams involved with this fun part of the hobby.

Digitized Voice?

With all broadcast radio going digital, as well as TV, we hams better start thinking in digital terms or we're going to be as far out of date as if we were still using spark gaps for our CW. Yes, I know, many old-timers are still upset over having to change to sideband 30 years ago. I think all of the "spark forever" crowd have finally won their Silent Keys certificates, though they were still a grumbling, resentful bunch when I started hamming in the 1930s.

With digital broadcast test stations showing three times the signal coverage with a hundreth of the power . . . plus the ability for six different stations to share each channel . . . digital is definitely coming. Sideband gave us six times the bang for the buck over AM, plus it allowed more stations per kHz. It certainly met the rule of thumb criterion for a new technology to be 10 times better than the old in order to survive. Well, so does digital, so nothing can stop it.

With that in mind I'd like to see some special temporary authority (STA) hams experimenting, complete with articles for *73*.

Data Compacting

In addition to the usual search for compressing algorithms, we might start setting up some protocols for packet and RTTY which would compress our transmissions. This doesn't even have to be high-tech. CW ops invented the Q-code to shorten their transmissions. So how about some simple look-up tables our computers can use to cut down on redundant messages? A sort of packet approach to the Q-code? For instance, "N>" might translate into "the name here is." We could even simplify names a bit with "Bob" being "bb" and "Bill" being "bl," Wayne being "wn," and so on. That would speed up the more common names.

With data compression we should be able to get contacts down to a few seconds of air time. "rv" could mean "the rig here is an ICOM 735." The second character could indicate up to 256 different models of rigs. Ditto for antennas. Yes, "q" would mean "I faithfully promise to send you a QSL card for this wonderful contact and hope that you will send one in return." A "w" with one added character would indicate up to 256 different kinds of weather, thus slicing at least two to three minutes of air time from every contact.

In this way we'll be able to make several contacts a minute and then read the expanded copy later when we have time. Few of us bother to comment on anything the other chap is saying anyway, so what's lost? The only really significant element of the contact is making sure you have the call right. You've got the *Callbook* on a CD-ROM, so you don't really need a location, unless he's portable.

With data compression we'll be well on our way toward completely automatic contacts. We'll be able to get reports from our computer on who we've contacted while we're at work or sleeping. Or watching ball games on TV. I'm reminded of RTTY back in 1950 when I'd come home from work and pick up 50 feet or so of printout and read what'd been talked about on the RTTY channel all day.

If we do find something of common interest we can send prewritten documents from our computers. In the old days we'd punch Teleptype tape with stories we might want to repeat. When there was an interest in some subject we'd load the tapes into the reader and they'd zip through at 60 wpm. It's a little easier today.

Oops, We Lost 100,000 Hams!

Just when we were all getting our arms out of joint congratulating ourselves on boosting our numbers to 600,000 licensed hams (FCC count), we get the bad news that the ARRL has done a survey and found that 16% of us are missing. Holy jumping Morse code, that's a hundred thou, pffft. How'd that happen?

Well, as I've been reminding you, and you've been ignoring, the FCC no longer bothers to delete our Silent Key award winners, nor our bored or unemployed dropouts. And with our licenses now good for 10 years, there's a lot of buried ham in the *Callbook*. Tons.

So, even with the increased input of no-code hams, are we breaking even? Maybe, just.

In looking over the ARRL survey, it seems like we have an awful lot of old-timers with a serious death wish for our hobby. I can't spread a lot of guilt on you because the chaps who are the problem don't read *73*. Most of them hate it.

Continued on page 78

NEW

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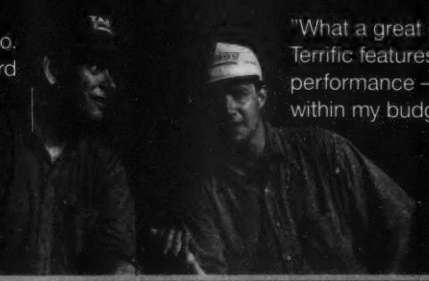

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LETTERS

From The Hamshack

Dick Beaton N7RB, Helena MT Wayne—As an old CW op, I'm not going to jump in and tell you that we have to keep all those CW frequencies or that CW is sacred. As a useful means of communication, it is a real dud. It's fun if you like it. It is hard to believe the ARRL still promotes traffic handling on phone and CW when packet will do it better and faster.

I was licensed in 1934 and worked as a CW operator in the CCC camps in North Dakota. Would you believe I furnished my own home-brew station? It was that job that helped me get a job with Northwest Airlines, first as a radio operator in '38, and later as a station manager in '42. We even used CW for handling reservation traffic from 1939 until about 1944! Before that it was all AM phone!

Well, anyway, I was one of the first around here to promote the no-code license idea. I've also been promoting your method of learning the code. I've taught code off and on for years and was one of the first VEs around here; also among the first on packet. At least in my case CW hasn't scrambled my brains and I could easily prove it. I don't get on as much anymore as most guys just won't talk. And I'm with you on QSLs! If a DX station gives me that old "QSL via a bureau," I just tell him "no QSL needed." They used to come with neat stamps on them. Now they are just another card in the drawer. (How about using packet for QSLs and making an excuse for sending traffic?) I don't even know how many countries I've worked and could care less. It isn't a big deal anymore. I do have WAS on Geritol net 3767 kHz. The only thing on my wall is a Kenwood world map and my "Ham of the Year" plaque from the local club.

One thing you could quit harping on is DXpeditions. The real truth is that very few of the hams I know could afford such a thing. Your background gets you into places that are out of reach to most others, so please quit comparing yourself with the rest of the hams. You are one of the privileged elite. As a VE, I know that some people have a tough time coming up with five bucks. I know how it is because I was one of them. You weren't.

When I was a kid we used to get the battery out of our Whippet to light the filaments in the old four-tube regenerative radio with a horn speaker. The problem was we went without radio a lot because the "B" battery didn't last very long. I set out to "invent" a substitute without spending any money because I didn't have any and my dad was on WPA. I succeeded, too! I didn't exactly know for sure what I was doing, but I ended up using a doorbell transformer to light the 201-A filament. I used one side of an audio transformer for a choke and the capacitor out of a Model T Ford coil for a filter. The plate and grid were tied together to make a diode that rectified the 110 AC. It worked like a charm.

After WWII I went through a lot of surplus gear modifications, etc. I never had an AM rig, just home-brew CW until the HW-101.

The mess on 14.313 makes me ashamed, but I have resisted the temptation to jump in and tell them off. It must be the big amplifiers those guys use that screws up their brains. I don't think the Extra Class license did it. I've got an amplifier, but haven't had it hooked up for a long time. Those old dudes who do talk don't have anything good to say, anyway. I used to check into the QCWA net in Montana and all those old guys do is talk about their health complaints and the weather.

Incidentally, you wanted to know what new products we use. Well, I had an R-5 vertical which worked great but was limited to bands higher than 40 meters, so I sold it and bought a GAP. It works fine, too, but on 80 the low angle of radiation makes it useless for visiting with guys within 100 miles or so. I tried to put a Bilal in the attic here without any success. Our attic goes up through a hole in the hall closet, so I had to give up trying to make it work. It doesn't even look like it should work!

I'm 76 years old and sorry I'm going to miss all the wonderful new things just over the horizon. Then again . . . I've lived to see one helluva revolution in the world of scientific knowledge. I missed a lot because I went to the college of hard knocks, but I think I know a lot more than quite a few college grads who never learned anything very useful.

One last thing: Hope you succeed in getting the school system fixed. Everyone should know Ohm's Law and DOS.

73 to a great editor. You and Rush Limbaugh should get together! You have a lot in common.

Dick—Elite? Me? Har-de-har. I've never been on a DXpedition that cost much. Travel is mostly a matter of decision. It doesn't have to cost a lot. For instance, Sherry and I spent a week in Rome last month. Wow, that must have cost a bundle! Well, we flew business class, stayed in a very nice hotel, went everywhere, saw everything, had some great dinners. Now how much would you budget for a trip like that, total?

The flight, hotel, meals, taxis, tips, and everything for a week came in at $551. A couple years ago we flew round-trip to Munich business class, rented a car, drove to Vienna, Krakow, Prague, and back to Munich. First class hotels. Fine meals. Two weeks. The total cost was under $1,000.

Of course I was able to do some business on each trip, which more than paid the cost of the trip. In Vienna I signed a contract with an Italian publisher to use 73 *articles. In Rome I made import agreements with two record companies. Travel doesn't have to be expensive if you do it right. And that includes DXpeditions.*

How much does it cost to drive to Halifax? Peanuts. Then there's the short flight to St. Pierre. The hotel was ridiculously inexpensive. So were fabulous meals. So we DXed there for a few days.

Any ham who has trouble coming up with $5 sure isn't much of an entrepreneur . . . and isn't using his ham know-how for anything but his own fun. There are too many easy ways to make money these days for anyone to be poor . . . unless they've been too lazy to get an education. Maybe you've noticed that there are very, very few well-educated poor people . . . and very few poorly-educated rich people. It's almost enough to make someone think.

College is a waste of time, no matter what you want to do. You can learn 10 times as much in half the time on your own. But then you want to keep right on and not stop. I'm still learning. I've read over 100 books in the last few months and have 50 more by my bed being read. No fiction . . . Wayne

Matt Thomas N8TWF, Ortonville MI I am writing to you because a few hams have really made me sick. I was scanning the 20 meter band not too long ago and heard a small group of hams cursing and swearing like mad on 14.315 MHz. What kind of representation of our great hobby is this? If I were a shortwave listener thinking of getting a license, this would probably convince me to change my mind. The only place I have heard more cursing is at school. I thought hams were to promote international good will. In my opinion, this hardly promotes international good will.

By the way, I really enjoy reading "Never Say Die." Wayne, you have some interesting opinions.

John R. Lowther, II, Lawrence KS I am writing in response to your "Never Say Die" column in the June 1993 issue. I have been a sporadic reader of *73* for years and your column is often the most interesting part of the magazine and certainly the most unpredictable.

In this column you hammered on one of the problems which has been keeping me from seriously pursuing an amateur radio license: There seems to be hardly anyone out there worth talking to. When I listen on the ham bands with my little Sony 2010 I find very little worth listening to. Using the receiver section of my elderly Drake TR-4C I find nothing more, despite its superior ability to separate one signal from the next.

I went through a study guide for the no-code Technician license and was surprised to find that the so-called "significant technical requirement" consists mostly of extremely basic electronic theory that anyone who has actually done anything with electronics should already know.

Of course, the no-code Technician license is not all that interesting, lacking privileges on the HF bands capable of reasonable reliable long-range contacts. Even with the addition of passing the 5 wpm Morse code test, only the 10 meter band is available for telephony, the other bands allowing only digital communications (including that most primitive of digital systems, CW).

If the ARRL cannot be pried away from the old incentive licensing scheme, perhaps the privileges for using manually-generated Morse code can be separated from the other privileges of the license so that having once passed the 5 wpm code test (3 wpm would be better), to meet the requirement of the treaty, you would gain all of the General Class privileges upon passing the General Class written test, except on frequencies designated for emission type A1A, only gaining A1A privileges on passing the 13 wpm code test, and likewise for the Advanced and Extra Classes.

This proposal would be consistent with the objective of the amateur radio service as a source for skilled electronics technicians, as it would provide rewards for gaining additional technical knowledge without holding the acknowledgment of their advance in knowledge hostage to skill in using an obsolescent (and I am tempted to say obsolete) communications technique.

Eric P. Nichols KL7AJ, North Pole AK Here's an interesting figure for you. I recently acquired an HF packet station (actually a by-product of the AMTOR station I wanted). At any rate, I opened up all the AX25 monitors and tuned to the 14.103 MHz PacketCluster, letting *everything* spill its guts out of my page printer. After a six-hour period, I did some statistics on the printout. Lo and behold, 98.4 percent of all printed matter was "overheard," i.e. addressing and error-correcting information. The remaining 0.6% of the printed matter was actual text. So, the point is that inanities are not restricted to phone bands, they are built into the very soul of packet radio! A little food for thought!

One *nice* thing about packet, though, is that I can selectively reject calls from such unwanted areas as Japan. I call my program my "JA notch," and it saves a whole lot of wasted time and effort. Back in my phone days I used to call "CQ no JAs," but someone told me that was uncouth. Packet allows me to be selectively rude (or rudely selective) with no guilt!

Mind you, I have nothing against Japan per se, but if you have ever operated in Alaska you will know that JAs are about all you can get without extensive maneuvering . . . they literally swarm the high bands. Most KL7s rely on vast quantities of front-to-back ratio to solve the problem, but that leaves something to be desired in case you want some *desired* Asian country!

By the way, I have devised a new, more efficient signal reporting system, one in which the typical QSO is contained within the report itself. The report has two numerals and two letters. A typical QSO might be like this:

"AL7HC, this is KL7AJ. Your report is 59YR."

"KL7AJ, this is AL7HC. Yer' report is 57IS. 73s."

"73s. KL7AJ clear."

Translation:

"AL7HC, this is KL7AJ, you're five by nine, the rig here is a Yaesu, and the weather is rainy."

"KL7AJ, this is AL7HC. Roger. Yer' five by seven, the rig is an ICOM, and the weather is sunny. 73s."

"73s. KL7AJ clear."

As you can clearly see, this four-character report is more than adequate for more than 98.4% of all amateur QSOs. For the long-winded, a third letter might be used to describe the current physical ailment: "H" for heart problems; "K" for kidney stones; "P" for prostate surgery, etc. 73

Low Cost GaAsFET PREAMPS

LNG-(*)

ONLY ***$59*** wired&tested

FEATURES:

- **Very low noise:** 0.7dB vhf, 0.8dB uhf
- **High gain:** 13-20dB, depends on freq
- **Wide dynamic range** - resist overload
- **Stable:** low-feedback dual-gate FET

**Specify tuning range: 26-30, 46-56, 137-152, 152-172, 210-230, 400-470, 800-960 MHz.*

LNW-(*) MINIATURE PREAMP

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- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

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LNS-(*) IN-LINE PREAMP

ONLY $89 kit, ***$119*** wired&tested

- GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.

**Tuning range: 120-175, 200-240, or 400-500.*

HELICAL RESONATOR PREAMPS

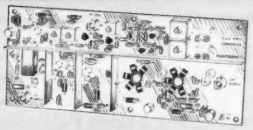
- GaAs FET preamps with 3 or 4 section helical resonators **reduce intermod & cross-band interference** in critical applications. **MODEL HRG-(*), *$80 vhf, $110 uhf.*** **Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-470.*

RECEIVING CONVERTERS

Low noise converters to receive vhf and uhf bands on a 10M receiver.

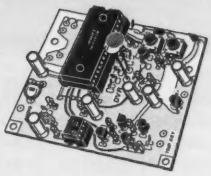
- **Kit less case *$49*, kit w/case & BNC jacks *$74*, w&t in case *$99*.**
- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).

TRANSMITTING CONVERTERS



XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

ACCESSORIES



NEW DVR-1 DIGITAL VOICE RECORDER Module. Primarily a **voice ID'er for repeaters**. May also be used as a **contest CQ caller** or as a **"radio notepad"** to record up to 20 seconds of received transmissions for instant recall. As a **repeater ID'er,** it will record your voice, using either the built-in microphone or an external mic. It can be used with almost any repeater COR module. As a **contest caller,** you can record a message or even several messages and play them through your transmitter at the press of a switch. As a **radio notepad,** you can keep it wired to the audio output of a receiver ready to record up to 20 seconds of anything you might want to recall later. Play it back as many times as you like through a small external speaker. (Call for more information.) .....kit $89, w&t $139

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. Designed **especially for repeaters,** with remote control activate/deactivate provisions ....kit $29, wired & tested $69

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier ..... kit $49

CWID. Diode programmed any time in the field, adjustable tone, speed, and timer, to go with COR-3 ..... kit $59

COR-4. Complete COR and CWID all on one board for easy construction. CMOS logic for low power consumption. Many new features. EPROM programmed; specify call ..... kit $99, w&t $159

TD-2 TOUCH-TONE DECODER/CONTROLLER. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too! .....kit $89, wired & tested $149

NEW TD-4 SELECTIVE CALLING Module. Economy touch-tone decoder with 1 latching output. Primarily designed to mute speaker until someone calls you by sending 4-digit tt signal but may also be used to turn on autopatch or other device..... kit $49, w&t $89

AP-3 AUTOPATCH. Use with above for repeater autopatch. Reverse patch and phone line remote control are std. .....kit $89, wired & tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver ..... kit $39

MO-202 FSK DATA MODULATOR. Run up to 1200 baud digital signals through any fm transmitter with full handshakes. Radio link computers, telemetry gear, etc. ..... kit $49, w&t $79

DE-202 FSK DEMODULATOR. For receive end of link. ..... kit $49, w&t $79

9600 BAUD DIGITAL RF LINKS. **Low-cost** packet networking system, consisting of MO-96 Modem and special versions of our 144, 220 or 450 MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W.

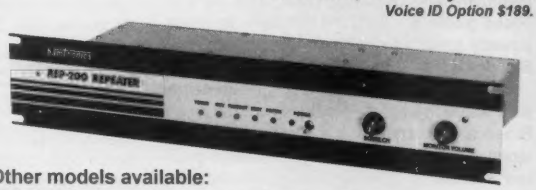
NEW **Real-Speech Voice ID Option Available With DVR-1 Digital Voice Recorder Shown At Left!**

REP-200 REPEATER

A microprocessor-controlled repeater with autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!

We don't skimp on rf modules, either! Check the features on R144 Receiver below, for instance: GaAs FET front-end, helical resonators, sharp crystal filters, hysteresis squelch.

Kit $1095; w&t only $1295!
Voice ID Option $189.



Other models available:

REP-200V Economy Repeater. As above, except uses COR-4 Controller without DTMF control or autopatch. **Kit only $795.**

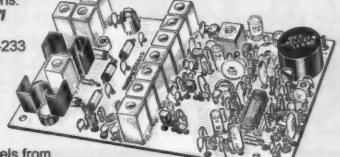
REP-200N Repeater with no controller. For use with external controller, such as those made by ACC. **Kit only $695, w&t $995.**

- Available for the 50-54, 143-174, 213-233, 420-475, 902-928 MHz bands.
- *FCC type accepted for commercial service (hi-band and uhf).*
- **Rugged exciter and PA**, designed for continuous duty.
- Power out 20W 50-54MHz; 15W (25W option avail.) 143-174MHz; 15W 213-233 MHz; 10W uhf; 10W 902-928MHz.
- Available add-on PA's **up to 100W.**
- **Six courtesy beep types**, including two pleasant multi-tone bursts.
- **Open or closed access autopatch, toll-call restrict**, auto-disconnect.
- **Reverse Autopatch,** two types: auto-answer or ring tone on the air.
- Pulse (rotary) dial option available.
- **DTMF CONTROL:** over 45 functions can be controlled by dtmf command. 4-digit control code for each function.
- **Owner can inhibit** autopatch or repeater, enable either open or closed access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr, and other options.
- Cw speed and tone, beep delay, tail timer, and courtesy beep type **can be changed at any time** by owner password protected dtmf commands.
- **Auxiliary receiver input** for control or **cross linking repeaters.**
- Many **built-in diagnostic** and testing functions using microprocessor.
- Color coded **LED's indicate status** of all major functions.
- **Welded rf-tight partitions** for exciter, pa, receiver, and controller.
- 3½ inch aluminum rack panel, finished in eggshell white and black.

XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

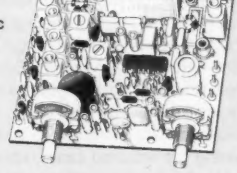
Also available in rf-tight enclosures, and with data modems.

FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***



- **TA51**: 50-54, 143-174, 213-233 MHz ...kit $109, w&t $189.
- **TA451**: 420-475 MHz ...kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.
- **VHF & UHF AMPLIFIERS.**
- For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.

FM RECEIVERS:



- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **GaAs FET** front end, 0.15uV sensitivity! Both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; afc tracks drift. ...kit $149, w&t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w&t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, GaAs FET front end. ...$169, w&t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res or afc. ...Kits $129, w&t $219.
- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Kit $129, w&t $219.

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RF Radiation Feedback

The FCC has extended the comment period on a proposal (in E.T. docket 93-62) that the commission adopt new guidelines for evaluating the environmental effects of radio frequency radiation. The federal agency will hear comments until November 13 on the proposed guidlines, which are the same as those already adopted by the American National Standards Institute and the IEEE.

The FCC says the request for extension was made by the National Association of Broadcasters, and was supported by other interested parties. The NAB's request was to allow a study to develop non-measurement-based techniques for complying with the Commission's new rules. *TNX Westlink Report No. 656, September 1, 1993.*

Vanity Callsigns Authorized

Both the House and Senate have approved legislation authorizing the FCC to issue unique amateur radio callsigns, at a cost of $7 per year, to the ham community. The surprise measure was inserted into the recently-signed deficit reduction bill of President Clinton.

According to a congressional aid close to the plan, "We envision that the legislation will probably be implemented so that an amateur pays $35 every five years, although there is no language in the bill that says they have to do it that way. It only says they have the authority because they do not have this authority right now. . . . As I understand it, the proceeds will go to the FCC to augment their budget, . . . pay for equipment, staff, and stuff." The only amateurs who would be subject to the new fees are those requesting special, distinctive callsigns.

Another little-known tack-on to the deficit plan provides for spectrum auctions. The government is set to receive more than $10 billion over the next five years when it sells radio spectrum to the highest bidder for new communications services. *TNX W5YI Report, Issue 16, August 15, 1993.*

Instant Ham

A petition has been filed before the FCC by the Western Carolina Amateur Radio Society VEC that seeks a rules change permitting instant ham radio licensing. Specifically, the Knoxville-based testing group wants the commission to ammend Part 97 to allow amateur radio operating privileges to commence upon passing the required exam, without having to wait for the issuance of a first license.

The WCARS VEC argument states that anyone who holds a valid Certificate of Successful Completion for an amateur operator's license which was issued within a year should be authorized with the rights and priviliges for that license class. They propose a temporary callsign structure based on the Class D citizen's radio service precedent which was set several years ago under deregulation. Proponents believe this measure would save the government time and money they spend answering phone calls from those waiting for their licenses to arrive.

This proposal, designated as RM-8288 is open for comments to the FCC. *TNX Westlink Report No. 656, September 1, 1993.*

Codeless Coast Guard

For the first time since 1924, the United States Coast Guard has closed down its Morse code operations on 500 kHz. The final CW transmission ended an era at 000Z, July 31, 1993. Coast Guard radio operators first began listening for distress signals on 500 kHz at the turn of the century, and set up its permanent station nearly 70 years ago to monitor the frequency continuously.

Officials say the advent of satellite and digital technology has made Morse code obsolete on the high seas. A misty-eyed Coast Guard radioman tapped out the final 73, saying "We now look forward to serving you on the next generation of communications equipment and systems via the Global Marine Distress and Safety System (GMDSS)." *TNX W5YI Report, Issue 16, August 15, 1993.*

Lunar Repeater

Northern California's Project OSCAR group has proposed installing the first repeater on the moon. Project OSCAR is the group that built and orbited the world's first amateur radio satellite. During recent meetings, the organization has decided to revive "Project Moonray" to take amateur radio into the 21st century.

Moonray is short for Moon Relay, a concept first proposed by W6OLO back in 1965. The idea was to build a repeater that would fit under the seat of the Lunar Rover. But, the project was shelved after Congress cut funding for manned moon missions beyond Apollo 17.

No specific timetable has been offered, although organizers hope to get the project off the ground by the turn of the century—which is only six years and a few months away. *TNX Westlink Report No. 655, August 13, 1993.*

Going Commercial?

We're not talking about the relaxed business communications rules which took effect in September. We're talking about Commercial Radio Operator License examinations. If you've been thinking about sitting for one of these exams, now may be your best chance.

While it may not be common knowledge, many of the questions for the General Radiotelephone Operator License examination are taken verbatum from the Amateur Advanced and Amateur Extra Class question pools. Those questions are expected to remain in the pool, at least through the summer of 1994—and possibly beyond.

A GROL is required to adjust, maintain, or internally repair transmitters in the avaition, maritime, and international fixed public radio services. The General Radiotelephone Operator License replaced the old First and Second Class Radiotelephone licences back in 1984. It is issued for the lifetime of the holder. *TNX W5YI Report, Issue 17, September 1, 1993.*

Chile Bird

The first Microsat of Chile, named *CEsar-1*, is slated for launch in early 1995, according to the Radio Club Federation in Santiago. The organization will control the new satellite, once it is in orbit.

The Microsat class bird will orbit at an altitude of 900 km. The Radio Club Federation says *CEsar-1* will boost communication between local amateurs and the rest of the world. *TNX Westlink Report No. 656, September 1, 1993.*

Island Quake Mobilizes Hams

The strongest earthquake to shake the world in more than four years rocked the island of Guam on August 8. The temblor struck early Sunday morning, measuring 8.1 on the Richter scale.

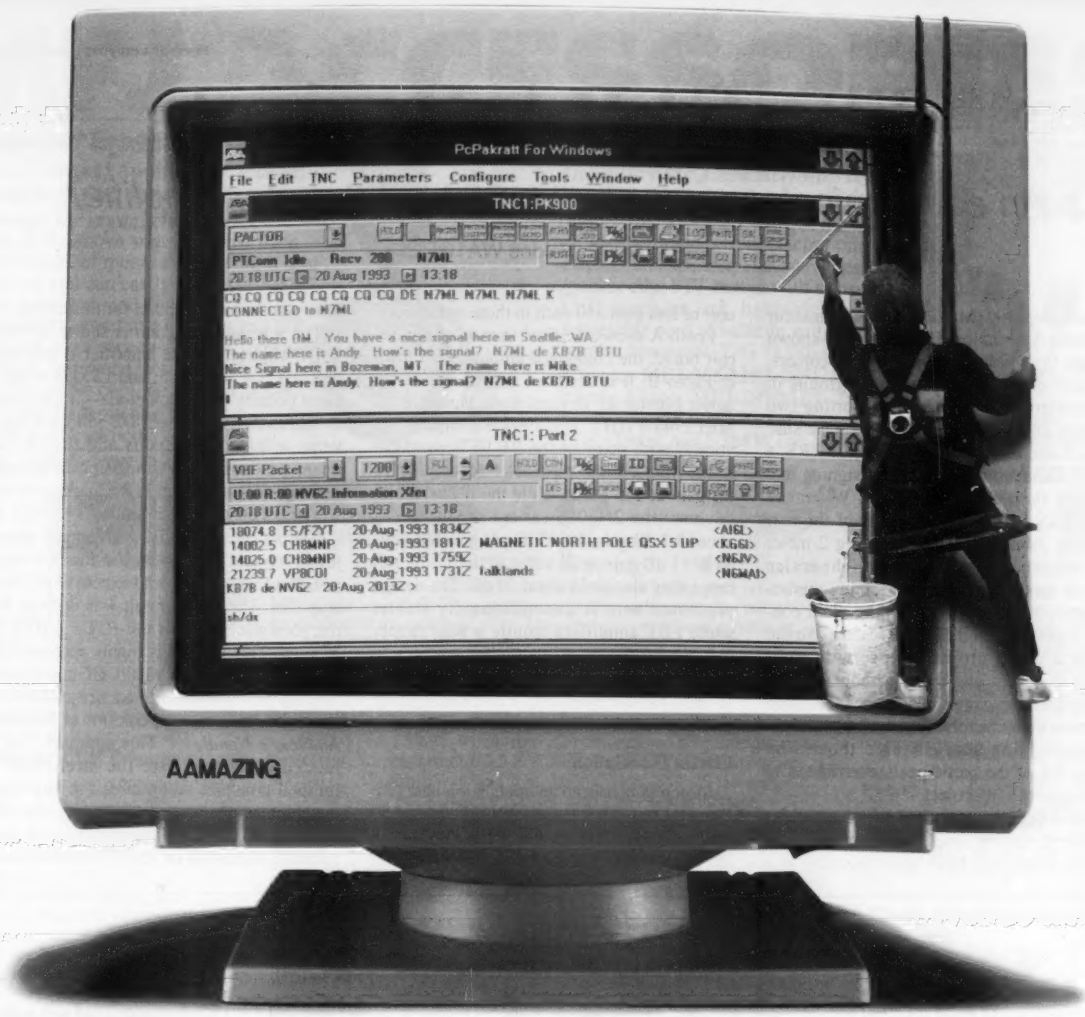
More than 130,000 island residents were left without electricity and at least 40 people were injured. Tourists fled from hotels where structural cracks were seen and bridges also suffered damage.

Communication with the northern part of the island became critical due to knocked-out telephone lines and the need for emergency services. Amateur radio and MARS stations were utilized to carry information to and from the disaster area.

Guam is west of the International Date Line, 3,800 miles west of Hawaii, and 1,500 miles south of Japan. There were no reports of injuries or damage at the US military facilities on the 30-mile-long island. *TNX Westlink Report No. 656, September 1, 1993.*

TNX . . .

. . . to all our contributors! You can reach us by phone at (603) 924-0058, or by mail at *73 Magazine*, Route 202 North, Peterborough NH 03458. Or get in touch with us on CompuServe ppn 70310,775; MCI Mail "WGEPUB"; or the 73 BBS at (603) 924-9343 (300-2400 baud, 8 data bits, no parity, one stop bit). News items that don't make it into *73* are often put in our other monthly publication, *Radio Fun*. You can also send news items by FAX at (603) 924-9327. 73


PcPakratt For Windows
File Edit TNC Parameters Configure Tools Window Help
TNC1:PK900
PACTOR
PTConn Idle Recv 200 N7ML
20:18 UTC 20 Aug 1993 13:18
CQ CQ CQ CQ CQ CQ CQ DE N7ML N7ML N7ML K
CONNECTED to N7ML
Hello there OM. You have a nice signal here in Seattle, WA.
The name here is Andy. How's the signal? N7ML de KB7B BTU
Nice Signal here in Bozeman, MT. The name here is Mike.
The name here is Andy. How's the signal? N7ML de KB7B BTU
TNC1: Port 2
VHF Packet
1200
U:00 R:00 NV6Z Information Xfer
20:18 UTC 20 Aug 1993 13:18
18074.8 FS/FZYT 20-Aug-1993 1834Z <AI6L>
14002.5 CH8MNP 20-Aug-1993 1811Z MAGNETIC NORTH POLE QSX 5 UP <KG6I>
14025.0 CH8MNP 20-Aug-1993 1759Z <N6JV>
21239.7 VP8COI 20-Aug-1993 1731Z falklands <N6MAI>
KB7B de NV6Z 20-Aug 2013Z >
sh/dx
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Tired of being controlled by your data controller software? Take control with PC-Pakratt for Windows. PC-Pakratt for Windows lets you do all the things you wanted to do in DOS but were afraid to try—or couldn't remember the command for.

With full Windows™ functionality (like background operation, cut & paste, etc.) and extensive on-line context-sensitive help, PC-Pakratt for Windows is the easiest way to use a data controller. You don't have to remember cryptic commands, either—just click a button and you're on your way.

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PC-Pakratt for Windows cleans up with top-notch features, too. Control two data controllers *simultaneously* for dual-, tri-, or even quad-port operation. Pick your favorite mode—PACTOR, Packet, AMTOR/SITOR, Morse, RTTY (Baudot/ASCII), NAVTEX, or TDM. PC-Pakratt for Windows supports all current AEA Data Controllers.

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Connect with us

The FARA Project

An economical, easy-to-build, 25 watt 2 meter amplifier.

by James R. Valdes WA1GPO

The Falmouth (Massachusetts) Amateur Radio Association (FARA) is well-known on Cape Cod for its hospitality to newcomers. It is also one of the more active groups in Southeastern Massachusetts supporting two repeaters and a digital Node/LAN. One subgroup of the association is the HACKERS, a group of amateurs who enjoy designing and building their own equipment. When the HACKERS noted that a majority of the new members joining FARA were using 2 meter HTs, we recognized that we might entice some of these new hams into joining this select group of builders by helping them construct a power amplifier for 2 meters. We did this as a group project: Those with tools drilled the holes and those without cleaned and prepped the circuit boards for fabrication or wound the inductors. Those who had experience building gear Elmered those who didn't. All of the participants contributed to the success of this project.

This article describes a 2 meter amplifier capable of running 25-30 watts output. More than 35 amplifiers have been procured at a cost of less than $50 each in these quantities.

Photo A shows the final version of the circuit board; the completed amplifier is shown in Photo B. It is designed around one of the newer bipolar RF devices from Motorola, an MRF1946A (Q1). This device compares favorably with many of the RF FETs available as the MRF1946 is capable of developing 10 dB gain at 146 MHz, while the older bipolar devices (the 2N6080 series) produce only about 5.7 dB gain. RF FETs are generally rated at 13 dB gain at 28 volts; in the 12-14 volt range they also yield about 10 dB. The design presented here is unconditionally stable, while FET amplifiers require a bias supply and careful tuning at the higher voltages to maintain stability. The cost of the MRF1946A is only about two-thirds that of the FETs, yielding the most "Bang for the Buck!"

Circuit Description

Motorola produced an application note (RF Device Data, Application AN955) for a 150 mW to 30 watt land mobile VHF amplifier in the 160 MHz range, based on the MRF1946. This was the starting point for this design.

The schematic diagram is shown in Figure 1. DC voltage into the amplifier is decoupled by C2, C3, L1, C4, C5, and L2. D2 is the reverse polarity protection diode—if the voltage is inadvertently reversed, D2 will limit the reverse voltage to 0.7 volts and fuse F1 will open, protecting the amplifier. The output stripline (Z1) described in the application note was lengthened for operation at 146 MHz and the output capacitor (C10) was empirically adjusted to yield an efficiency in the 70% range, just about what one would expect of a Class-C amplifier. The input circuit was derived from the formulas given in the *RSGB VHF/UHF Manual*. This manual is highly recommended for those interested in VHF/UHF construction. Similar examples of impedance calculations can be found in several editions of *The Radio Amateur's Handbook*. This approach was intended to demonstrate the microstrip vs. lumped constant techniques for impedance matching as one of the more subtle objectives of the HACKERS group is to provide some informal education on radio construction and

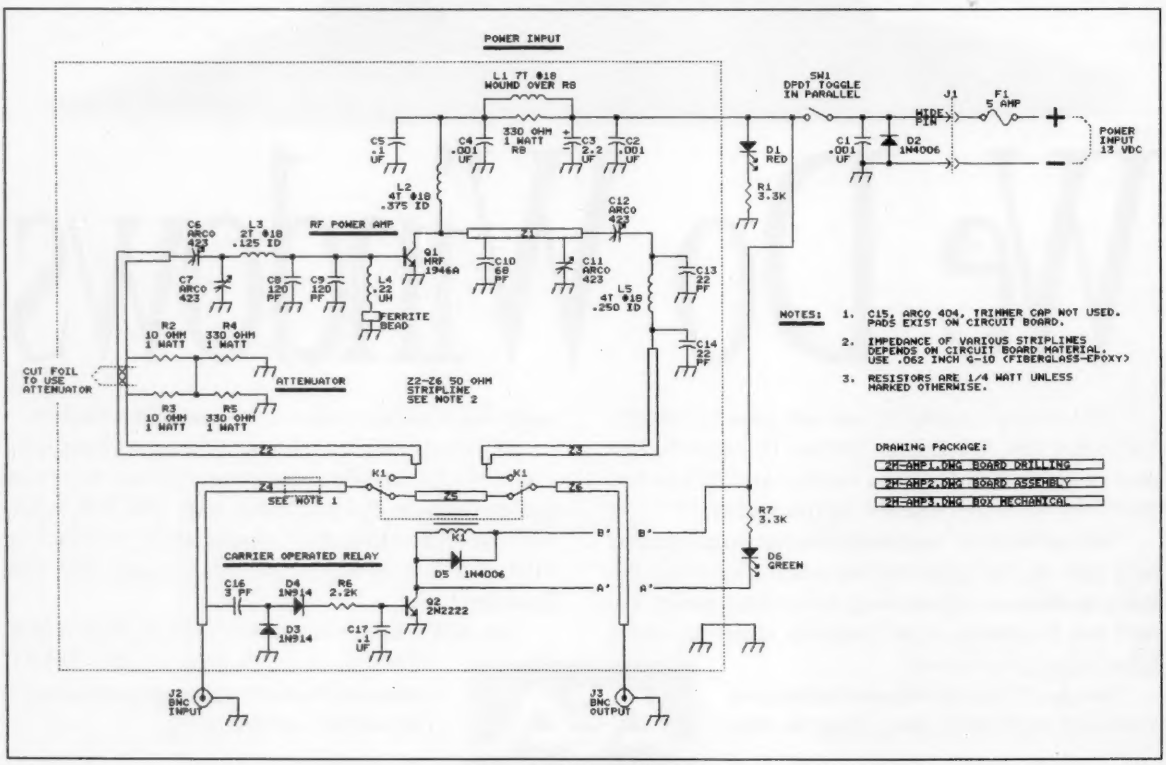

Figure 1. Schematic diagram.

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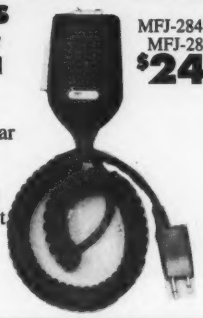

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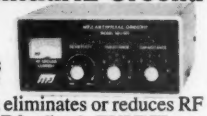

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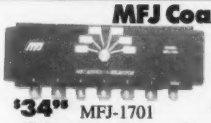

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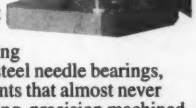

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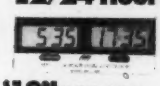

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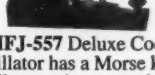

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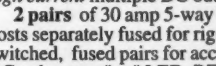

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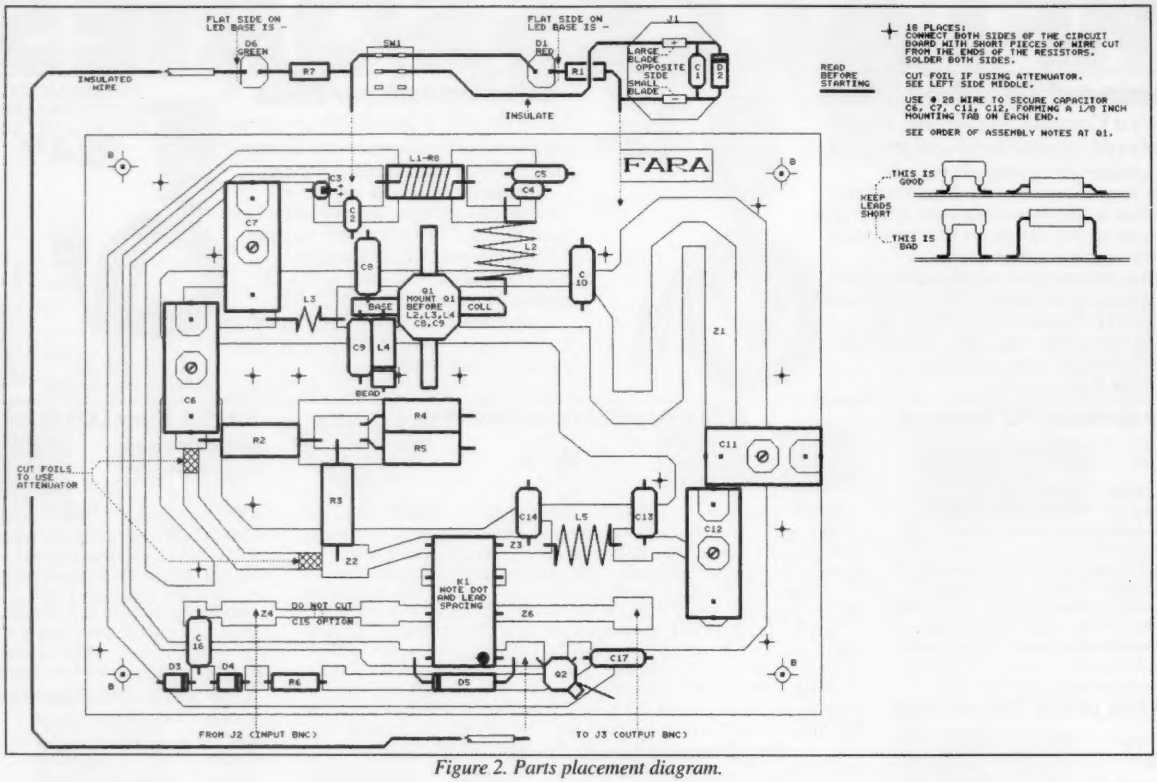

Figure 2. Parts placement diagram.

design practices. A low-pass filter network (C13,C14,L5) is in series with the output to enhance harmonic rejection.

Incorporated into the design is a resistive input attenuator network (R2,R3,R4,R5). The RF power transistor (Q1) is intended to be driven with 2 to 3 watts input; higher drive levels will not increase the output substantially. Most of the older HTs can drive the amplifier directly, but the new breed of high power, 4 to 7 watt HTs will require the input attenuator. When the attenuator is used, the 50 ohm microstrip must be isolated at the 10 ohm resistors. Cut the circuit foil at the locations noted on the parts placement diagram, Figure 2. The attenuator represents a nominal 3 dB loss; that is, half of the power is dissipated in the network. In addition to limiting the drive power to a safe level, the attenuator also enhances the stability of the amplifier by isolating the amplifier from the driver. It also presents a nominal 50 ohm resistive load to both units. If the attenuator is not required, the network consisting of resistors R2,R3,R4,R5 should be omitted.

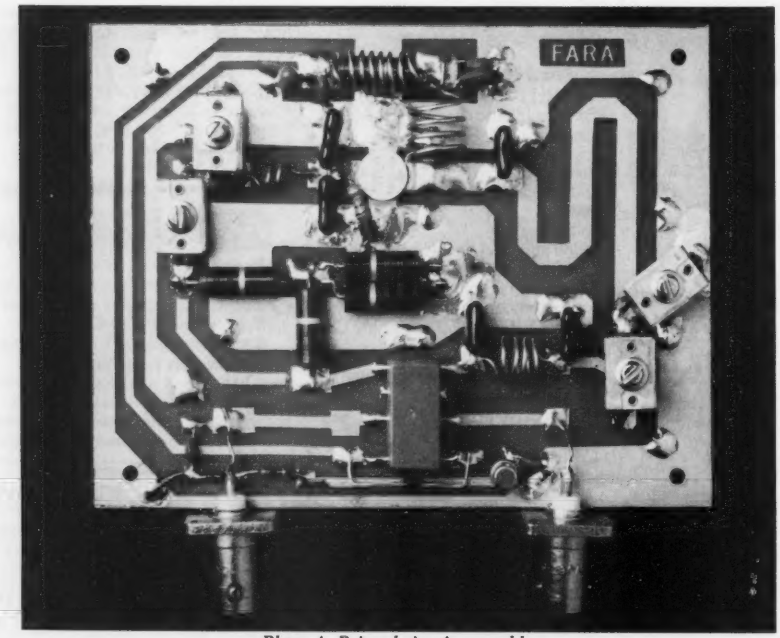

Photo A. Printed circuit assembly.

An RF-actuated T/R relay (K1) has been incorporated into the amplifier. RF on the input is sampled by C16, rectified and limited by D3, D4, R6, and C17 to turn on Q2, which pulls in the relay. We considered using solid-state T/R switching. However, relay switching has the advantage that the amplifier can be turned off when it is not required. Conversely, diode-switched amplifiers must be powered at all times. This is in keeping with the spirit of the FCC regulations that require radio amateurs to use "the minimum power necessary to carry out the desired communications." Relay switching also results in a more compact, easier-to-duplicate amplifier. The relay specified in the Parts List is a small, open-frame style. Its performance is adequate for 2 meters.

Should you be a "purist," you can compensate for the inductance of the relay by installing a variable capacitor (C15) in series with the input to the relay, as noted on the parts placement diagram. This capacitor was

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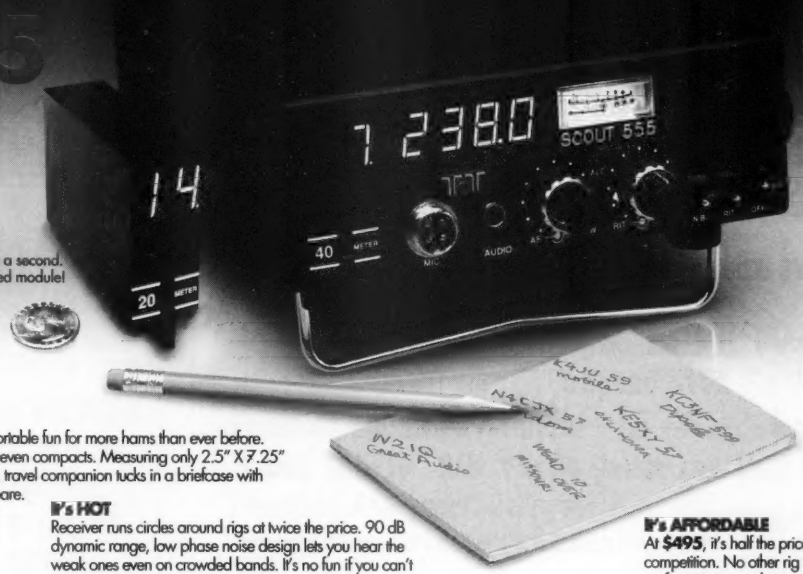

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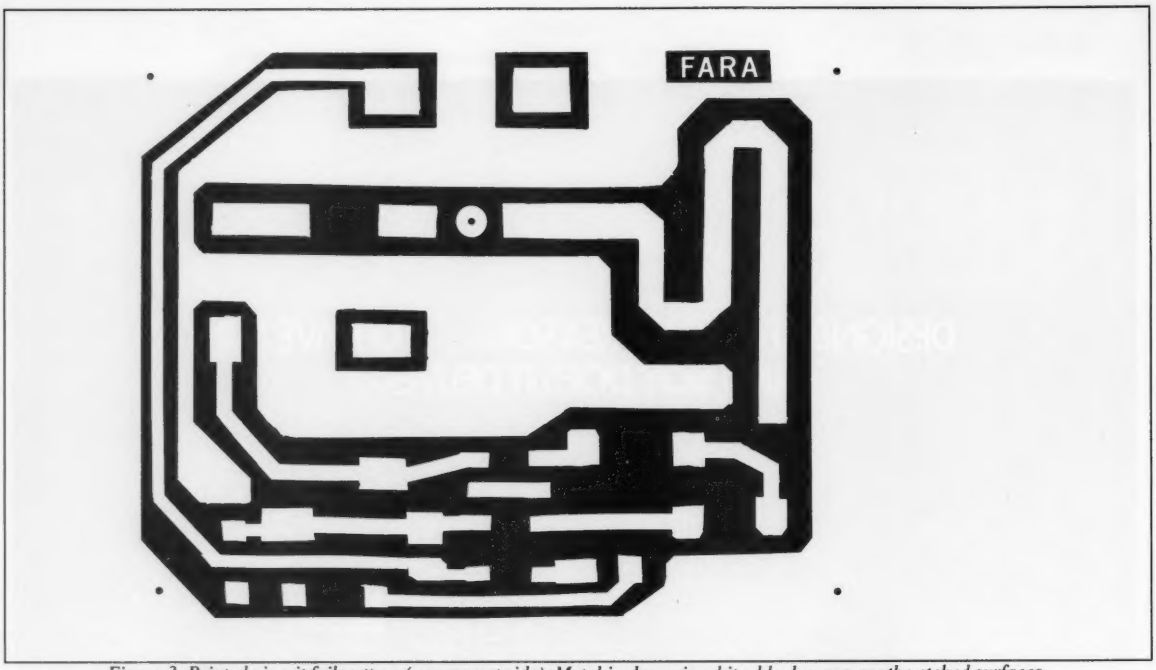

Figure 3. Printed circuit foil pattern (component side). Metal is shown in white, black areas are the etched surfaces.

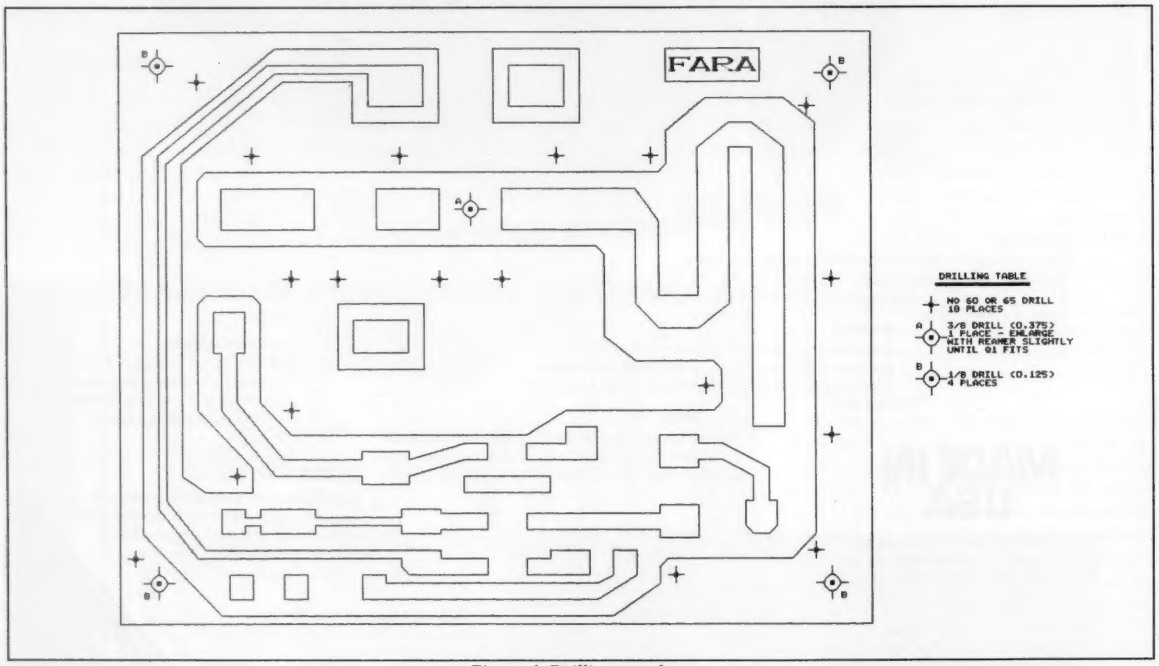

Figure 4. Drilling template.

not used on our production run. All of the input and output foil runs are constructed of 50 ohm microstrip (Z2-Z6) etched into the circuit board. The circuit can be modified for solid-state T/R switching. A PIN Diode T/R switch may be a better choice for packet operations, which require high speed switching. Several articles (including "A 2 Meter FET Amplifier for Your Handheld" by John Cunningham AA4AW, *73 Amateur Radio Today*, Oct. 1992, p.20) and the ARRL handbooks contain examples of diode switching.

A word of caution concerning the circuit board. It must be constructed of 1/16", double-sided, G-10 glass-epoxy board with 2 or 3 oz. copper. A full-size negative for the circuit board is provided (see Figure 3). The side of the board opposite the stripline remains a solid copper ground plane as it is not etched. Failure to reproduce the board exactly as shown, with the materials specified, will dramatically affect the performance of the amplifier because the dimensions for the striplines are critical.

Low impedance grounds are crucial to the operation of the amplifier. A number of holes (18) must be drilled through the board (see Figure 4). No. 20 wire is inserted through these holes and soldered to electrically tie both sides of the circuit board together at the

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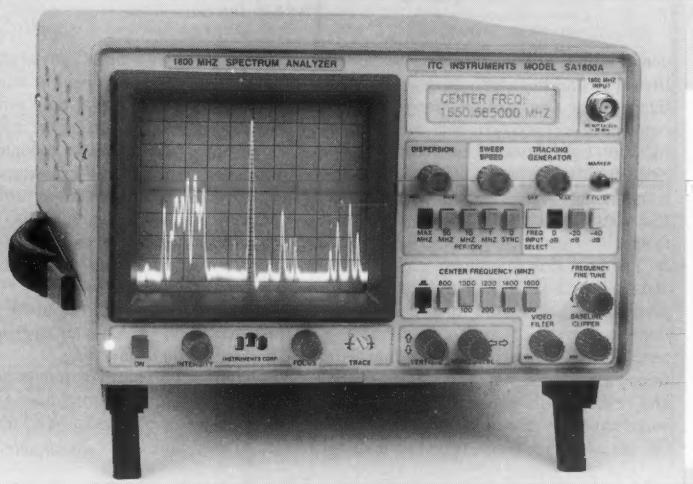

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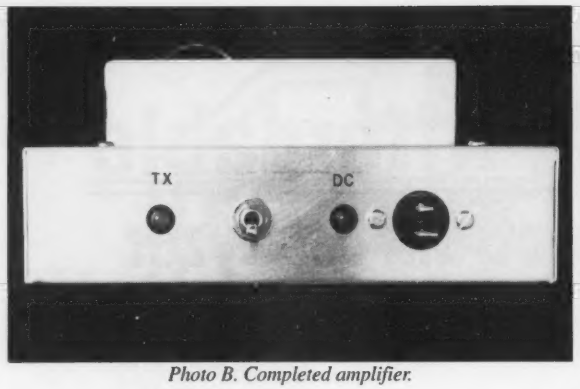

Photo B. Completed amplifier.

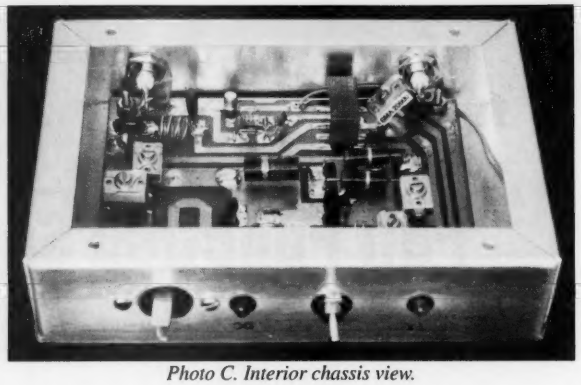

Photo C. Interior chassis view.

points indicated. Some flux may enhance the solderability on the ground plane side of the circuit board. Be sure to use only rosin core-solder!

Construction

Photo C is a view of the amplifier mounted in the suggested enclosure; it should be noted that the circuit board shown in this view is one of the earlier prototypes. It's a good idea to use the circuit board as a template to mark the case for the mounting holes before soldering the components to the board.

The MRF1946A utilizes an 8-32 stud for the heat sink and mounts with a single hole through the circuit board. Take care when mounting the device to insure that no strain is placed on the transistor's leads when it is soldered. It must fit flush on the circuit board. A little thermal heat-sink compound on the flange of the transistor mounting stud is recommended to maximize heat transfer. Careful—don't get this stuff on your clothes because you'll never get it off! The circuit board mounts to the case with 4-40 hardware. Use 4-40 nuts under the circuit board corners to space the transistor mounting stud correctly. The heat sink (aluminum channel stock) and the chassis details are given in Figure 5. I prefer BNC connectors for the RF connections as they mount with a single hole and perform better that UHF connectors at the frequencies of interest. The LEDs, switches, and reverse polarity protection diode are wired from the case-mounted components to the circuit board. Don't forget to install the fuse in series with the DC power plug.

Attention should be paid to standard VHF construction practices. Some pitfalls to be aware of when constructing the amplifier are:

•Components should be mounted flush to the board; i.e., the fixed capacitors should be mounted as close to the foil as possible. Bend the leads perpendicular to the body after removing any enamel from the leads, then solder the components to the board with the minimum lead length possible.

•The wires through the board should be bent into a "Z" shape after insertion through the board prior to soldering.

•Periodically, the flux should be removed from the board during the construction process. Pay particular attention to the striplines

Continued on page 18

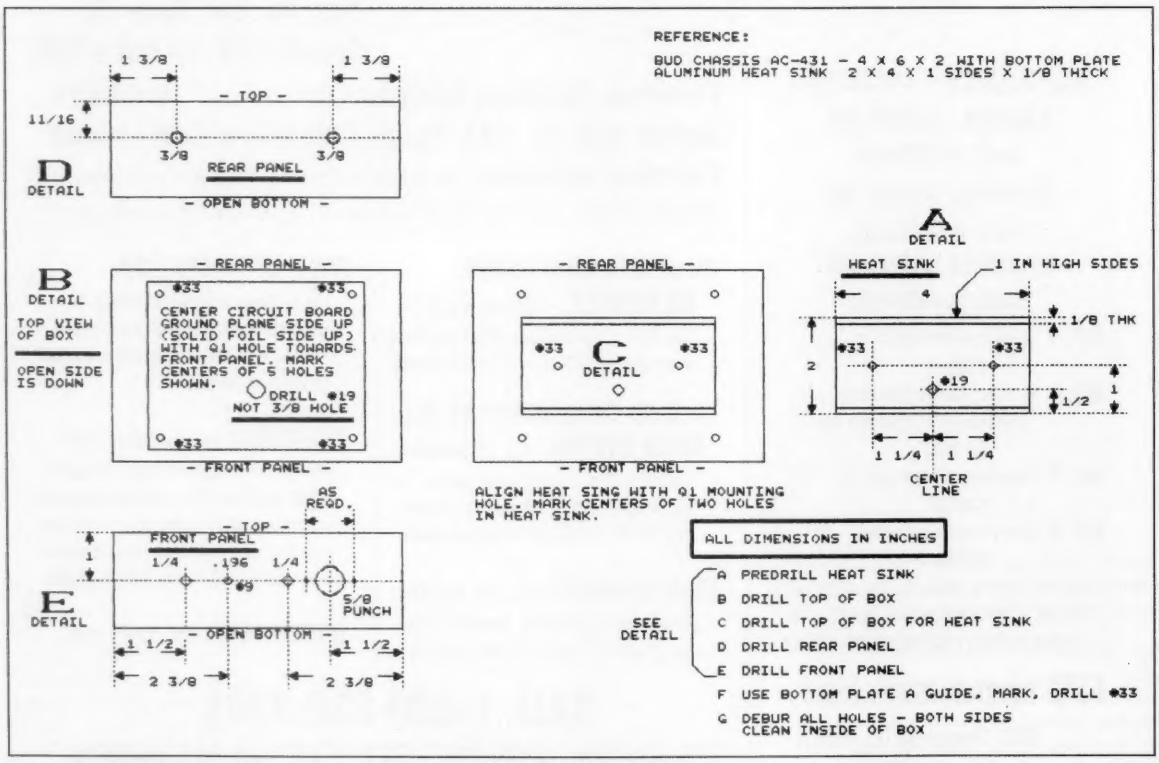

Figure 5. Chassis details.

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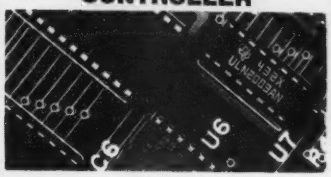

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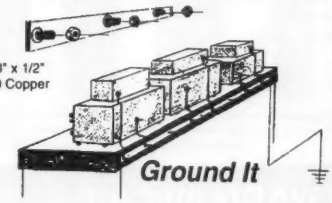

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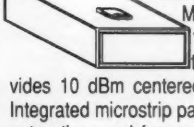

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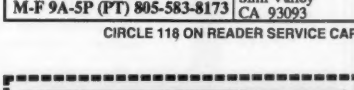

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The FARA Project

Continued from page 16

and the transistor mounting tabs. These areas must be *clean*. If not, you may have some difficulties when tuning the amplifier.

Parts List

Component	Type	No. Required	Source
C1,C2,C4	0.001 µF	3	
C5,C17	0.1 µF	2	
C8,C9	120 pF	2	
C10	68 pF	1	
C13,C14	22 pF	2	
C16	3 pF	1	
C3	2.2 µF	1	
C6,C7,C11,C12	ARCO 423	4	CS/RF
C15	ARCO 404	1	CS/RF
R1,R7	3.3k, 1/4W	2	
R2,R3	10 ohm, 1W	2	
R4,R5,R8	330 ohm, 1W	3	
R6	2.2k, 1/4W	1	
Q1	MRF 1946 A	1	RF
Q2	2N2222	1	
D1	LED—red	1	
D6	LED—green	1	
D2,D5	1N4006	2	
D3,D4	1N914	2	
L1	7T, #18 wound over R8		
L2	4T, #18 3/8" i.d.		
L3	2T, #18 1/8" i.d.		
L5	4T, #18 1/4" i.d.		
L4	0.22 µH w/ferrite bead		CS
K1	Relay, P/N ME431-ORV-SH-212L		M
J1	2-pin, Jones/TRW/Cinch		
J2,J3	BNC chasis receptacle, UG1094/U		
CH1	Bud chasis AC-431, 4" x 6" x 2"		
BP1	Bud bottom plate, 4" x 6" inches		
HS1	Heat sink, 2 x 1 x 4 channel stock		

Misc. #4 hardware
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CS: Circuit Specialists, Inc., Tel. 1-800-528-1417

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•With the large ground plane of the circuit board you must be careful that there are no cold solder joints. The joints should be shiny and should puddle well after soldering; they should not look crystalline or like a blob. Good soldering techniques are crucial to the performance of the amplifier.

Tune Up

The amplifier is quite easy to tune: Only a DC ammeter (5A full-scale), a 12-14 volt 5A power supply, a suitable RF power meter (50 watts full-scale), and dummy load are required. Initially the amplifier should be tuned at 12 volts with an input power of no more than 1 watt. Until the amplifier is completely tuned, RF should be applied to the input for no more than three to five seconds at any one time. Prior to mounting the amplifier in the enclosure you should rough-tune the amplifier. Be sure the transistor is mounted to the heat sink when tuning.

Tune the amplifier as follows:

1. Apply 12 volts, with the ammeter in series with the positive lead. There should be no current indicated on the meter. Set the power switch to OFF, then peak the relay compensating capacitor (C15), if installed, for maximum output in the bypass mode.
2. Turn the power switch ON and apply 1 watt (as noted). The relay should pull in. Tune all capacitors (C6,C7,C11,C12) for maximum output. Do not tune the relay compensating capacitor (C15) at this time.
3. Set the power supply voltage to 14 volts and increase the drive to the maximum 2 to 3 watts input at the transistor, 4 to 7 watts *maximum* at the input of the amplifier, provided the attenuator is in place.
4. Again, tune the capacitors for maximum output.

Pay attention to the current being drawn. You will notice a substantial increase in current when the series output capacitor (C12) is off resonance. Tune the amplifier for the best efficiency; that is, tune for the highest power output consistent with the minimum current being drawn. Nominal values are about 3.5 amperes at 28 watts output.

Results

To date, the 30 amplifiers we have built have been a great success! The primary goal of the Hackers Group—that of introducing new hams to the construction side of the hobby—was met. They were able to construct a useful piece of equipment at a nominal cost and they enjoyed doing it.

This was a group project and everyone who participated contributed to its success. I would personally like to acknowledge the support of four individuals: Don N1JCT, who helped coordinate the project and who prodded me into designing the unit; Bob W1HWU, whose expertise in circuit board fabrication was crucial to the success of the project; Harry W2RKB, who helped with the circuit boards and tune-up; and, last but not least, John N1ILO, who provided the CAD drawings. 73

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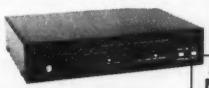

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This article improves upon my original "Mobile Extender Using VOX Control" project, which first appeared in the December 1987 issue of *73* (pages 44-45). While the original project worked OK—it had a few drawbacks. For one thing, it utilized parts which are difficult to impossible to find today. This new and improved version solves that problem and goes a step further. It uses commonly available parts but also works quite a bit better. This version also eliminates the intermittent reception problem which cropped up in the original, thereby improving communications.

Why Build the Extender?

This project can be invaluable at parades, public events, and especially in search and rescue work. When the extender is operating, you can leave your vehicle and still be in contact with others on the repeater channel via the extender. This is important if you can't access the local repeater via your handie-talkie in your portable location. Using the extender allows you to use the higher power mobile radio in your vehicle to access the repeater. You will also have the advantage of a gain mobile antenna over a rubber duckie.

Circuit Description

In the original circuit, the speaker output of the receiver went to an audio transformer, with a diode in series on the secondary, which produced a DC voltage to drive the input of an LM3900 Norton op amp IC. This arrangement was satisfactory, but at times would become intermittent due to voltage changes on the input to the LM3900. The improved version, shown in Figure 1, is not as dependent on varying input voltages, thereby making the circuit more reliable. Voice modulation is no longer required to activate the circuit. Instead, it will activate upon hearing the receiver noise, when the squelch is opened.

Two identical circuits, using a single LM386 400 mW audio amplifier IC in each channel, instead of a single LM-3900 IC, are built to make the extender. The 1RF511 power MOSFET is available from Radio Shack and other suppliers. If a relay output is desired, the 1RF511 can be replaced by an NPN transistor. The 1RF511 has very low on-state resistance, combined with high transconductance, and the capability of sinking 3 amperes.

When the gate of the MOSFET is driven high, the drain goes low, which will key the T/R relay in the transceiver. The only voltage on the drain is supplied by the relay of the radio. Parallel to the drain output of the MOSFET is an over-voltage protection circuit consisting of a zener diode (Z1, Z2), and a 0.01 µF disc capacitor (C7, C16) to prevent voltage spikes from destroying the MOSFET.

Diodes (D1, D2) rectify the output voltage of the LM386 IC from AC to DC, to operate the MOSFET keying transistor (or NPN/re-

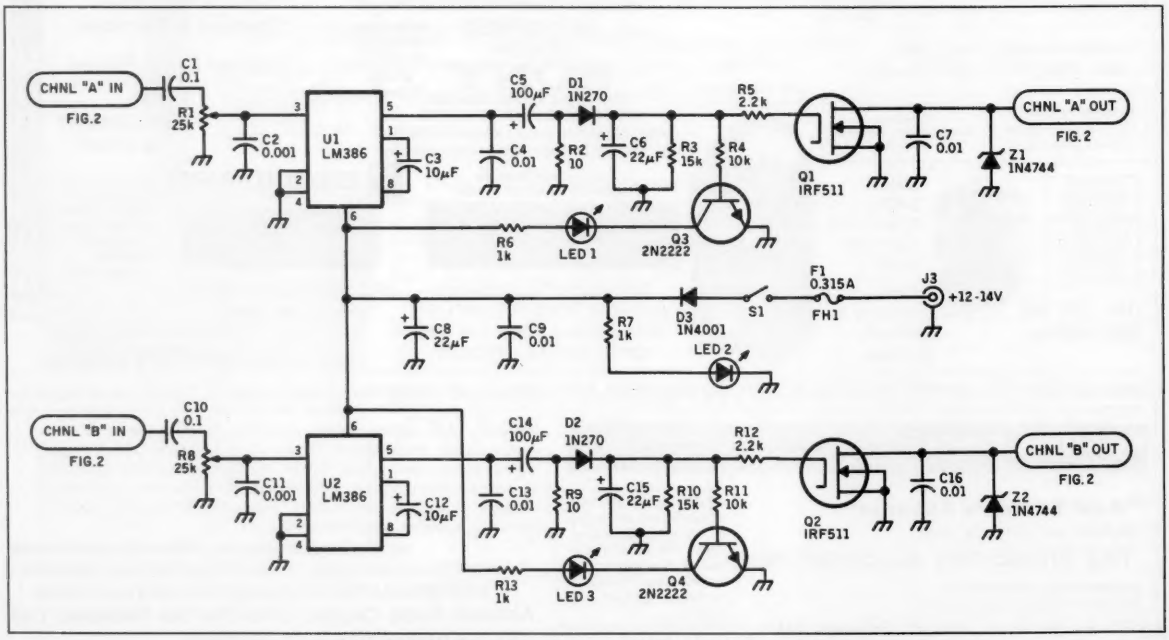

Figure 1. Schematic for the improved VOX Mobile Extender.

RAMSEY ELECTRONICS

COM-3 $2995.00

2 WAY RADIO SERVICE MONITOR

COM-3, the world's most popular low-cost service monitor. For shops big or small, the COM-3 delivers advanced capabilities for a fantatic price—and our new lease program allows you to own a COM-3 for less than $3.00 a day. Features •Direct entry keyboard with programmable memory •Audio & transmitter frequency counter •LED bar graph frequency/error deviation display •0.1–10.000 µV output levels •High receive sensitivity, less than 5 µV •100 kHz to 999.9995 MHz •Continuous frequency coverage •Transmit protection, up to 100 watts •CTS tone encoder, 1 kHz and external modulation.

RSG-10 $2495.00

SYNTHESIZED SIGNAL GENERATOR

Finally, a low-cost lab quality signal generator—a true alternative to the $7,000 generators. The RSG-10 is a hard working, but easy to use generator ideal for the lab as well as for production test. Lease it for less than $3.00 a day. Features •100 kHz to 999 MHz •100 Hz resolution to 500 MHz, 200 Hz above • 130 to + 10 dBm output range •0.1 dB output resolution •AM and FM modulation •20 programmable memories •Output selection in volts, dB, dBm with instant conversion between units •RF output reverse power protected •LED display of all parameters—no analog guesswork!

FREQUENCY COUNTERS

CT-70 7 DIGIT 525 MHz | **CT-90 9 DIGIT 600 MHz** | **CT-125 9 DIGIT 1.2 GHz**

Ramsey Electronics has been manufacturing electronic test gear for over 10 years and is recognized for its lab quality products at breakthrough prices. All of our counters carry a full one-year warranty on parts and labor. We take great pride in being the largest manufacturer of low-cost counters in the entire U.S.A. Compare specifications. Our counters are full-featured, from audio to UHF, with FET high impedance input, proper wave shaping circuitry, and durable high quality epoxy glass plated-thru PC board construction. All units are 100% manufactured in the U.S.A. All counters feature 1.0 ppm accuracy.

NEW CT-250 2.5 GHZ

ACCESSORIES FOR COUNTERS

Telescopic ship antenna—BNC plug, WA-10	$11.95
High impedance probe, light loading, HP-1	$16.95
Low-pass probe, audio use, LP-1	$16.95
Direct probe, general purpose use, DC-1	$16.95
Tilt bail, elevates counter for easy viewing, TB-70	$ 9.95
Rechargeable internal battery pack, BP-4	$ 8.95
CT-90 oven timebase, 0.1 ppm accuracy, OV-1	59.95

ALL COUNTERS ARE FULLY WIRED & TESTED

MODEL	FREQ. RANGE	SENSITIVITY	DIGITS	RESOLUTION	PRICE
CT-50	20 Hz–600 MHz	< 25 mV to 500 MHz	8	1 Hz, 10 Hz	$189.95
CT-70	20 Hz–550 MHz	< 50 mV to 150 MHz	7	1 Hz, 10 Hz, 100 Hz	$139.95
CT-90	10 Hz–600 MHz	< 10 mV to 150 MHz < 150 mV to 600 MHz	9	0.1 Hz, 10 Hz, 100 Hz	$169.95
CT-125	10 Hz–1.25 GHz	< 25mV to 50 MHz < 15 mV to 500 MHz < 100 mV to 1 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$189.95
CT-250	10 Hz–2.5 GHz typically 3.0 GHz	< 25 mV to 50 MHz < 10 mV to 1 GHz < 50 mV to 2.5 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$249.95
PS10B Prescaler	10 MHz–1.5 GHz, divide by 1000	< 50 mV	Convert your existing counter to 1.5 GHz		$89.95

SPEED RADAR $89.95 complete kit SG-7

New low-cost microwave Doppler radar kit "clocks" cars, planes, boats, horses, bikes or any large moving object. Operates at 2.6 GHz with up to 1/4 mile range. LED digital readout displays speed in miles per hour, kilometers per hour or feet per second! Earphone output allows for listening to actual doppler shift. Uses two 1-lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

BROADBAND PREAMP

Boost those weak signals to your scanner, TV, shortwave radio or frequency counter. Flat 25 dB gain, 1 to 1000 MHz. 3 dB NF. BNC connectors. Runs on 12 VDC or 110 VAC.
PR-2, wired, includes AC adapter $59.95

2M POWER AMP

Easy to build power amp has 8 times power gain, 1W in, 8W out, 2W in, 16W out, 5W is for 40W out. Same amp as featured in many ham magazine articles. Complete with all parts, less case and T-R relay.
PA-1, 40W pwr amp kit $34.95
TR-1, RF sensed T-R relay kit $11.95

FM WIRELESS MIKE KITS

FM-3 SHOWN

Pick the unit that's right for you. All units transmit stable signal in 88-108 MHz FM band up to 300' except for hi power FM-4 that goes up to 1/2 mile.
FM-1, basic unit $5.95
FM-2, as above but with added mike preamp $7.95
FM-4, long range, high power with very sensitive audio section, picks up voices 10' away $14.95
MC-1, miniature sensitive mike cartridge for FM-1,2,4 ..... $2.95

MICROWAVE INTRUSION ALARM

A real microwave Doppler sensor that will detect a human as far as 10 feet away. Operates on 1.3 GHz, and is not affected by heat, light, or vibrations. Drives up to 100 mA output, normally open or closed, runs on 12 VDC.
Complete kit MD-3 . $19.95

MUSIC MACHINE

Neat kit that will produce 25 different classical and popular tunes, plus 3 doorchime sounds. Lots of fun for doorbells, shop, or store entrances, car horn, music boxes, etc. Runs on 9V battery or wall transformer. Excellent speaker volume and adjustable tempo and pitch. Add our case set for a handsome finished look.
Complete kit, MM-5 ..... $24.95
Case + knob set, CMM-5 .. $12.95

PACKET RADIO

Two new versions are available for the Commodore 64 (P-64A) or the IBM-PC (P-IBM). Easy assembly "NO TUNING". Includes FREE disk software, PC Board and Full Documentation.

KIT	P-64A	$59.95
	P-IBM	$59.95
CASE	CPK	$12.95

LO NOISE PREAMPS

Make that reciever come ALIVE! Small size for easy installation with Hi-Q tuned input for peak performance. Excellent gain and noise figure—guaranteed to improve reception! Specify band: 2M—PR-10, 220 MHz—PR-20, 440 MHz—PR-40.
Each kit $17.95

TONE DECODER

A complete tone decoder on a single PC board. Features: 400–5000 Hz adjustable range via 20-turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit, TD-1 $6.95

VOICE ACTIVATED SWITCH

Voice activated switch kit provides switched output with current capability up to 100 mA. Can drive relays, lights, LED, or even a tape recorder motor. Runs on 9 VDC.
VS-1 kit. $6.95

TELEPHONE TRANSMITTER

Mini-sized with professional performance. Self-powered from phone line, transmits in FM broadcast band up to ¼ mile. Installs easily anywhere on phone line or inside phone!
PB-1 kit $14.95

NEW

SPEAKER PHONE

Talk on the phone hands-free, great to put in shop or shack, press the button to answer—no actual phone needed. Works same as commercial units. Talk from anywhere in room, phone line powered—no battery needed. Super for family and conference calls or buy two for hands-free intercom! Add our case set for a pro look.
SP-1 ..... $29.95 Case-CSP $12.95

TICKLE STIK

A shocking kit! Blinking LED attracts victims to pick up innocent-looking can—you watch the fun! Ideal for office desks, parties, nosey know-it-alls!
TS-4 kit $9.95

LIGHT BEAM COMMUNICATORS

Transmits audio over infrared beam up to 30'—use simple lenses to go up to ¼ mile! Hum free, uses 30 kHz carrier. Great for wireless earphones or undetectable "bug."
Transmitter + receiver set, LB56 . $19.95

FM RADIO

Full-fledged superhet, microvolt sensitivity, IC detector and 10.7 MHz IF. Tunes Std. FM broadcast band as well as large portions on each end. Ideal for "bug" receiver, hobby experiments or even as FM radio!
FR-1 kit $19.95

SUPER SLEUTH

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2W rms output. Runs on 6 to 15 volts, uses 8–45 ohm speaker.
BN-9 kit $6.95

BROADBAND PREAMP

Very popular sensitive all-purpose preamp, ideal for scanner, TVs, VHF/UHF rigs, counters. Lo noise, 20 dB gain, 100 kHz–1 GHz, 9V–12 VDC operation.
SA-7 kit $14.95

•2 METERS •223 MHz •440 MHz

$149.95

FANTASTIC FM TRANSCEIVERS

SYNTHESIZED—NO CRYSTALS

Ramsey breaks the price barrier on FM rigs! The FX is ideal for shack, portable or mobile. The wide frequency coverage and programmable repeater splits makes the FX the perfect rig for Amateur, CAP or MARS applications. Packeteers really appreciate the dedicated packet port, "TRUE-FM" signal and almost instant T/R switching. High speed packet? . . . .No problem. Twelve diode programmed channels, 5W RF output, sensitive dual conversion receiver and proven EASY assembly. Why pay more for a used foreign rig when you can have one AMERICAN MADE (by you) for less. Comes complete less case and speaker mike. Order our matching case and knob set for that pro look.

FX-146 kit (2 Meters)	$149.95
FX-223 kit (1¼ Meters)	$149.95
FX-440 kit (3/4 Meters)	$189.95
CFX matching case set	$ 24.95

2 MTR & 220 BOOSTER AMP

Here's a great booster for any 2 meter or 220 MHz hand-held unit. These power boosters deliver over 30 watts of output, allowing you to hit the repeater's full quieting while the low noise preamp remarkably improves reception. Ramsey Electronics has sold thousands of 2 meter amp kits, but now we offer completely wired and tested 2 meter, as well as 220 MHz, units. Both have all the features of the high-priced boosters at a fraction of the cost.
PA-10 2 MTR POWER BOOSTER (10 X power gain)
Fully wired & tested $89.95
PA-20 220 MHz POWER BOOSTER (8 X power gain)
Fully wired & tested $89.95

QRP TRANSMITTERS HAM RECEIVERS

20, 30, 40, 80M CW TRANSMITTERS

Join the fun on QRP! Thousands of these mini-rigs have been sold and tons of DX contacts have been made. Imagine working Eastern Europe with a $30 transmitter—that's ham radio at its best! These CW rigs are ideal mates to the receivers at right. They have two-position variable crystal control (one popular QRP XTAL included), one watt output and built-in antenna switch. Runs on 12VDC. Add our matching case and knob set for a handsome finished look.
Your choice of bands $29.95
(Specify band: QRP-20, 30, 40 or 80)
Matching case & knob set, CQRP $12.95

20, 30, 40, 80M All Mode RECEIVERS

Build your own mini ham station. Sensitive all-mode AM, CW, SSB receivers use direct conversion design with NE602 IC as featured in *QST* and ARRL handbooks. Very sensitive varactor tuned over entire band. Plenty of speaker volume. Runs on 9V battery. Very EASY to build, lots of fun and educational—ideal for beginner or old pro. New 30-page manual. Add the case set for well-fitted professional look.
Your choice of bands $29.95
(Specify band: HR-20, HR-30, HR-40, HR-80)
Matching case & knob set, CHR $12.95

E-Z KEY CMOS KEYER

Send perfect CW within an hour of receiving this kit! Easy-to-build kit has sidetone oscillator, speed control and keys most any transmitter. Runs for months on a 9V battery. 28-page manual gives ideas on making your own key for extra savings. Add our matching case set for complete station look.
CW-7 kit $24.95
Matching case knob set, CCW $12.95

ACTIVE ANTENNA

Cramped for space? Get longwire performance with this desktop antenna. Properly designed unit has dual HF and VHF circuitry and built-in whip antenna, as well as external jack. RF gain control and 9V operation makes unit ideal for SWLs, traveling hams or scanner buffs who need hotter reception. The matching case and knob set gives the unit a hundred dollar look!
AA-7 Kit $24.95
Matching case & knob set, CAA $12.95

SPEECH SCRAMBLER

Communicate in total privacy over phone or radio. Kit features full duplex operation using frequency inversion. Both mike and speaker or line in/out connections. Easy hookup to any radio, and telephone use requires no direct connection! Easy to build 2 IC circuit. Can also be used to descramble many 2-way radio signals. Finish your kit off with the handsome case & knob set.
SS-7 kit $29.95
Matching case & knob set, CSS $12.95

SHORTWAVE RECEIVER

Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4–11 MHz. True superhet has smooth varactor tuning, AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3–22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!
Shortwave receiver kit, SRI $29.95
Shortwave converter kit, SCI $27.95
Matching case set for SRI, CSR $12.95
Matching case set for SCI,CSC $12.95

2, 6, 10 MTR, 220 FM RECEIVERS

Keep an ear on the local repeater gang, monitor the cops, check out the weather or just plain listen around. These sensitive superhet receivers are just the ticket. They tune any 5 MHz portion of the band and have smooth varactor tuning, dual conversion with ceramic IF filters, AFC, adjustable squelch and plenty of speaker volume. Runs on 9V battery and performance that rivals the big rigs! For a complete finished pro look, add our matching case and knob set with screened graphics.
FM communications receiver kit $29.95
Specify band: FR 146 (2m), FR6 (6m), FR10 (10m), FR-220 (220 MHz)
Matching case & knob set, CFR $12.95

FM STEREO TRANSMITTER

Run your own stereo FM station! Transmit a stable signal in the standard FM broadcast band throughout the house, dorm or neighborhood. Connects easily to line outputs on CD player, tape decks, etc. Runs on 9V battery, has internal whip antenna and external antenna jack. Add our case set for a "station" look!
FM-10 kit $29.95
Matching case set, CFM $12.95

AIRCRAFT RCVR

Hear exciting aircraft communications—pick up planes up to 100 miles away! Receives 110–136 MHz AM air band, smooth varactor tuning superhet with AGC, ceramic filter, adjustable squelch, excellent sensitivity and lots of speaker volume. Runs on 9V battery. Great for air shows or just hanging around the airport! New 30-page manual details pilot talk, too. Add case set for "pro" look.
AR-1 kit $24.95
Matching case set, CAR $12.95

TERMS: Satisfaction guaranteed. Examine for 10 days. If not pleased return in original form for refund. •Add $3.75 for shipping, handling and insurance. •For foreign orders add 20% for surface mail. •COD (U.S. only), add $5.00. • Orders under $20, add $3.00. •NY residents add 7% sales tax. •90-day parts warranty on kit parts. •1-year parts & labor warranty on wired units.

VISA MasterCard

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CIRCLE 34 ON READER SERVICE CARD

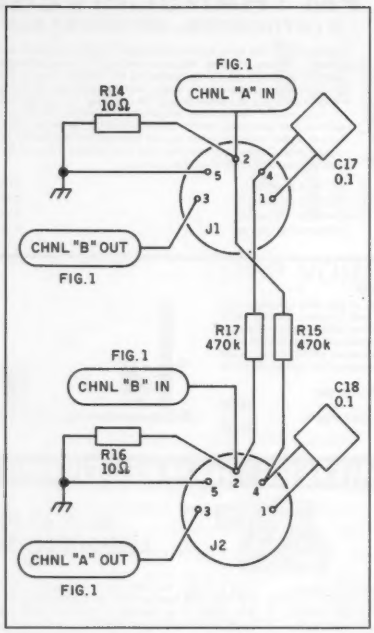

Figure 2. The 5-pin DIN jack wiring.

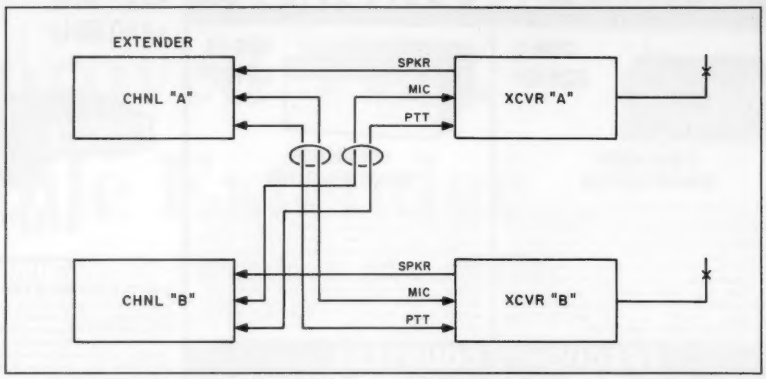

Figure 3. It's easy to hook up the Extender to your radios.

lay configuration). The LED indicators are optional, but they do give a visual indication as to which channel is active. I use a red LED for "CHNL A," green for "CHNL B," and yellow for POWER ON.

Transmit Audio Circuit

The transmit audio section is identical to the original article. The speaker output of one receiver goes through a 470k ohm resistor (R15, R17), to a 0.1 µF capacitor (C17, C18), then terminates at the microphone input of the other transmitter. The values of the resistor/capacitor network may vary, depending on your radio, but the device has been found to work with several different types. It is suggested that the network be placed directly at the I/O jacks (J1, J2), instead of on the PC board. See Figure 2.

Wiring It Up

Figure 3, the wiring diagram, shows how simple it is to hook it up to your radios. XCVR "A" speaker output goes to CHNL "A" input; CHNL "A" output (MIC/PTT) goes to XCVR "B" microphone/PTT jack (reverse for the other channel). XCVR "A" should be on your 2 meter repeater channel, or can be on simplex. XCVR "B" can be on your 2 meter repeater channel, or can be on simplex. XCVR "B" can be on any simplex channel, preferably on either 220 or 440 MHz, to prevent desense.

Operation

To use the unit, plug in the appropriate cables to the transceivers. The input/output jacks (J1, J2) of the extender are wired the same, so all you need to make up are the cable connectors going to your transceivers. Refer to your radio's manual for correct wiring and types of connectors required.

Select XCVR "A" to an active repeater channel; set the volume control on the receiver to about halfway on each radio for initial tests. Monitor on another receiver; set to XCVR "B" transmit frequency, and adjust the 25k pot (R1) to where the circuit keys XCVR "B."

Now adjust the receiver volume to where the audio has good quality. Again, these values may need to be changed to fit your radio, but they should be correct for most units. Now you can do XCVR "B," which is the same procedure. The 5-pin DIN jack wiring is shown in Figure 2.

Construction

The circuit can be constructed on a printed circuit board from FAR Circuits (see note at the end of the Parts List). Place the board, along with the associated switches, LEDs and jacks, in a metal box of your choice and mount it in a suitable location near

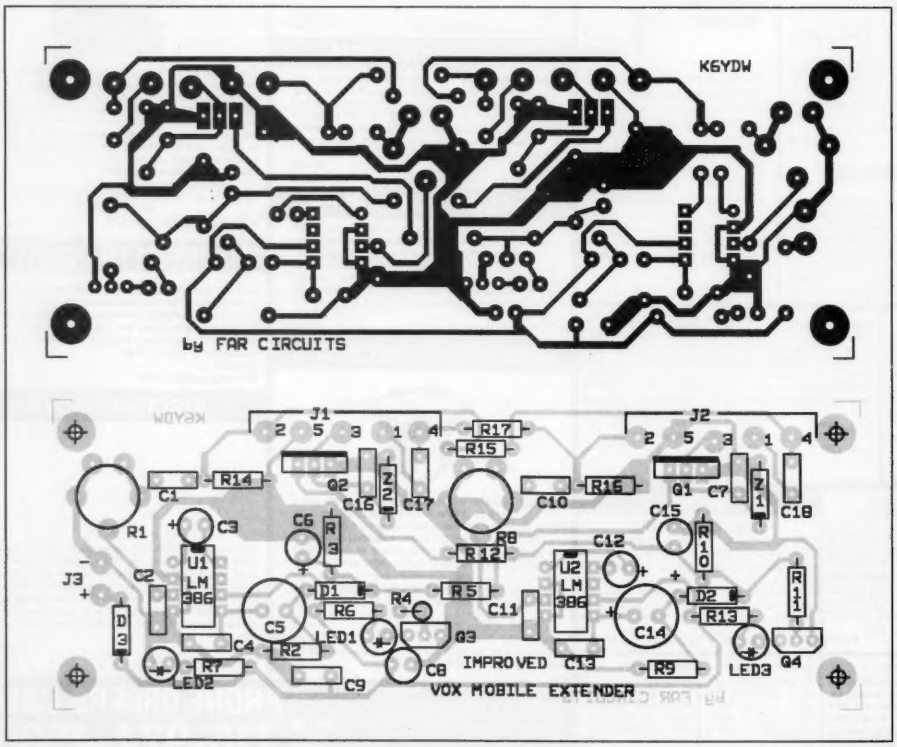

Figure 4. PC board pattern and parts placement.

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MODEL VS-50M

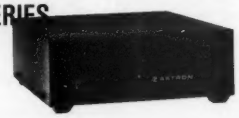
SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES



- LOW PROFILE POWER SUPPLY

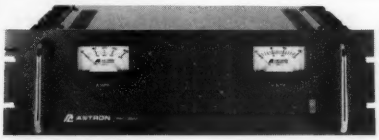
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

- POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

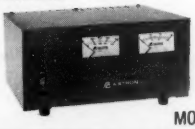
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

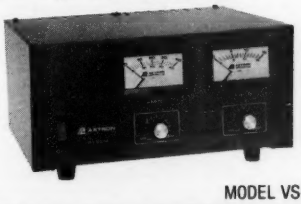
RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES



MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

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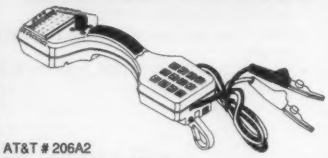
TELEPHONE LINE TEST HANDSET



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These rugged line test handsets were originally designed for use with AT&T's "Craft Access" computer. They can be used like any other line test handset, but they have special features which may or may not be useful. In addition to the touch-tone keypad, talk/monitor switch, alligator clip leads, 4 conductor modular jack and tool belt clip, these units have a LCD screen and function button/joystick for use with AT&T's "Craft Access" computer. For the average user, the extra features mainly allow you to adjust the volume and program in phone numbers. The main drawback to these units is that they contain batteries that require recharging, and the test set should be recharged when not in use. The size of the unit is 12.5" long X 4.5" wide. Brand new, in the box. They include 2 ni-cad battery packs, a charger and instructions.

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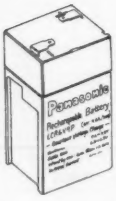

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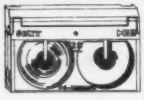

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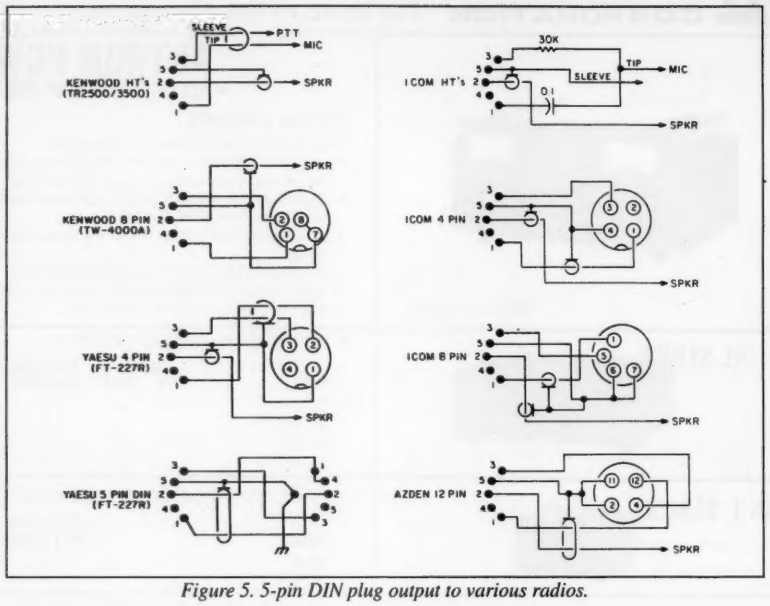


Figure 5. 5-pin DIN plug output to various radios.

the transceivers. The fuse F1 and the switch S1 are mounted off the PC board on the enclosure box. The cost of this project is less than $50 if all the parts are purchased new; less, of course, if you have a good junk box. Pinouts for various radios can be found in Figure 5 in this article.

Reminders

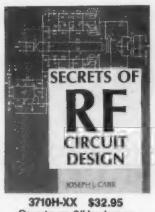
Remember to wait for the repeater squelch-tail to drop before transmitting through the extender. *Be advised: You have just created a remote base, which you must ID as such, per FCC rules.* 73

Parts List

Integrated Circuit		
U1,2	LM386 audio amp	RS 276-1731
Transistor		
Q1,2	1RF511 Power MOSFET	RS 276-2072
Q3,4	2N2222 NPN	RS 276-2009
Diodes		
D1,2	1N270 (or 1N914/1N4148)	RS 276-1122
D3	1N4001 50V/1A	RS 276-1101
Z1,2	1N4744 Zener, 15V/1W	
LED1	Red T-1 3/4	RS 276-041
LED2	Yellow T-1 3/4	RS 276-021
LED3	Green T-1 3/4	RS 276-022
Resistors		
R1,8	25k ohm PC mount pot	
R2,9,14,16	10 ohm, 1/2W	RS 271-001
R3,10	15k ohm, 1/4W	RS 271-1337
R4,11	10k ohm, 1/4W	RS 271-1335
R5,12	2.2k ohm, 1/4W	RS 271-1325
R6,7,13	1k ohm, 1/4W	RS 271-1321
R15,17	470k ohm, 1/2W	RS 271-053
Capacitors		
C1,10,17,18	0.1 µF/50V Mylar	RS 272-1069
C2,11	0.001 µF/50V disc	RS 272-126
C3,12	10 µF/16V tantalum	RS 272-1436
C4,7,9,13,16	0.01 µF/50V disc	RS 272-131
C5,14	100 µF/35V electrolytic	RS 272-1028
C6,8,15	22 µF/16V tantalum	RS 272-1437
Jacks		
J1,2	5-pin DIN	RS 274-005
J3	5mm/2.1mm power	RS 274-1565
Plugs		
P1,2	5-pin DIN	RS 274-003
P3	5mm/2.1mm power	RS 274-1567
Switch		
S1	SPST sub-mini	RS 275-612
Fuse		
F1	.315A/5x20mm	RS 270-1249
FH1	Fuseholder, 5x20mm	RS 270-362
Other		
Cabinet	Metal	RS 270-253
PC Board	Universal Board	RS 276-168

A drilled and etched PC board for this project is available for $7.50 plus $1.50 S&H from FAR Circuits, 18N640 Field Ct., Dundee IL 60118.

3627P $19.95



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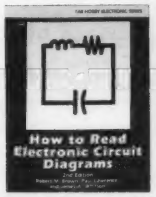

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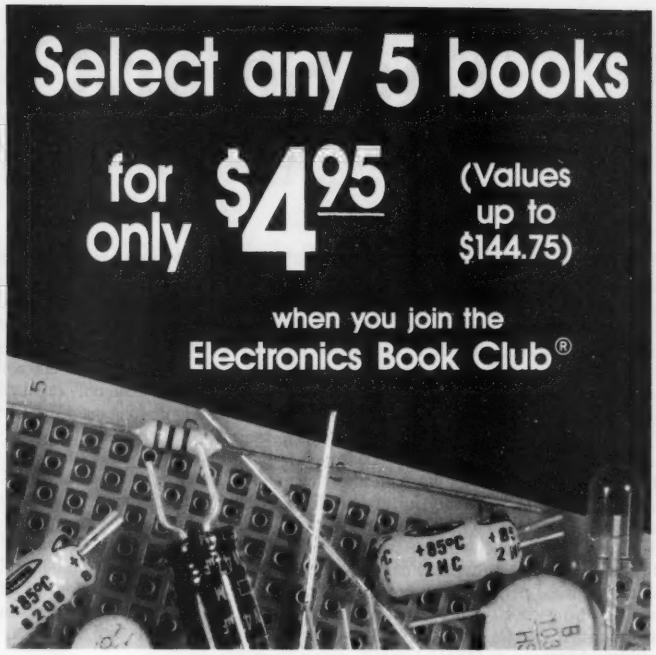

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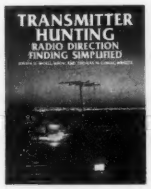

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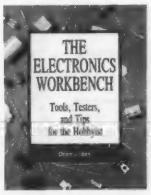

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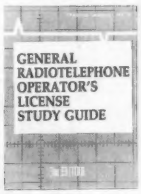

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The Solar Control-ar

A solar panel charge controller for all seasons.

by Joel R. Donaldson WB5PPV

My home is on wheels. My ham shack is on wheels. I live in an old motor home, often staying for months in remote areas that lack any AC power. I'm no rugged old geezer when it comes to creature comforts, however. My idea of roughing it is having to warm something up on the gas stove, instead of cauterizing it in the microwave. Given this affinity for modern gadgets (and my inability to convert my Yaesu to operate on propane gas), I've been forced to come up with alternate ways of obtaining electricity for my comfort and pleasure. My RV came equipped with a big, stupid Onan generator. It uses a little less than a gallon of fuel for every hour of operation, regardless of whether or not it's powering anything. It's cranky to start on cold mornings. It interferes with my TV and HF reception. During weekly skeds on 20 meters, I find myself shouting into the microphone to make myself heard over it. It hunts, surges, and revs for no apparent reason. It sets off my smoke alarms, even when it isn't actually on fire. In short, it stinks. Literally.

After several months of power generation aggravation, I bought a combination inverter/battery charger so I wouldn't have to run the generator all the time. It's coolness incarnate! It's 85 to 90 percent efficient, and completely silent. You have 120 volts AC whenever you want, with the flick of a switch. Yep, I'll only have to run the generator for several hours a day now, just long enough to recharge the RV batteries, right? Well, not exactly. As it turns out, you can only rapid-charge a lead-acid battery up to about 75 percent of its total capacity. After that, the last 25 percent takes a *long* time, regardless of how big your battery charger is. Try to save some time by really cranking up the charge current and all you get is a boiling battery with melted plates. Great. Now I can run the generator for two hours to build up the bulk of the battery charge, and then run it for another four or five hours just to top it off. Or I can shut it down after several hours and live with undercharged batteries, right?

Well, not exactly. As it turns out, an excellent method for prematurely ruining a lead-acid battery is to consistently undercharge it. In the process of discharging, the lead plates in a battery are converted to lead sulfate. If the battery is promptly and fully recharged, this sulphation is almost completely driven back into solution, leaving the plates essentially unchanged. However, if the battery is not completely recharged, the sulphation hardens into a form that is eventually not removable with any amount of recharge. When this happens, there is less plate area available in which chemical reactions can occur, and the battery permanently loses capacity. The process continues until the battery can't hold any charge at all, and . . . it's toss time!

So much for quick charges with the generator. I really need a scheme that provides a gentle, continuous low-current battery charge over long periods of time, say maybe five to eight hours, something that is quiet, doesn't stink or guzzle gasoline, is easy to maintain, and doesn't need to be attended while it's doing its thing.

Well, you know what the answer had to be.

Shortly after I mounted four 53 watt Siemens solar panels on the roof of the RV, I began to search for a good charge controller. I looked at both the store-bought and the roll-your-own types. Most charge controllers don't exactly teeter on the leading edge of technology, but the way some of them work is still kind of neat. Unfortunately, all of them I looked at suffered from at least one of the following maladies:

•1. They were expensive.

•2. They were either incapable of controlling a large number of solar panels (typically being limited to a maximum of 8 to 15 amps), or they wouldn't work with anything less than a large number of panels.

•3. They were inefficient, with a significant percentage of the panel array's total power output being wasted as heat within the charge controller.

•4. They lacked truly useful metering capabilities.

•5. They lacked sufficient adjustability, or the adjustments wouldn't stay put.

•6. They couldn't be manually bypassed in case of failure or for routine battery equalization.

•7. They had little (if any) immunity to strong RF fields.

With these problems in mind, I set out to design my own controller. In addition to avoiding everyone else's pitfalls, I had to make the final design simple and use readily-available parts. Because several hundred to several thousand amp-hours of storage batteries represent a considerable investment, the design also had to be reliable. No one wants to leave their house, RV or repeater site unattended for an extended period, only to later discover that the controller has failed in the "on" position, indefinitely subjecting their batteries, inverter, radios and other appliances to the full 18 to 20 volts produced by their solar panels. Or, just as bad, failed in the "off" position, with the batteries totally Tango Uniform.

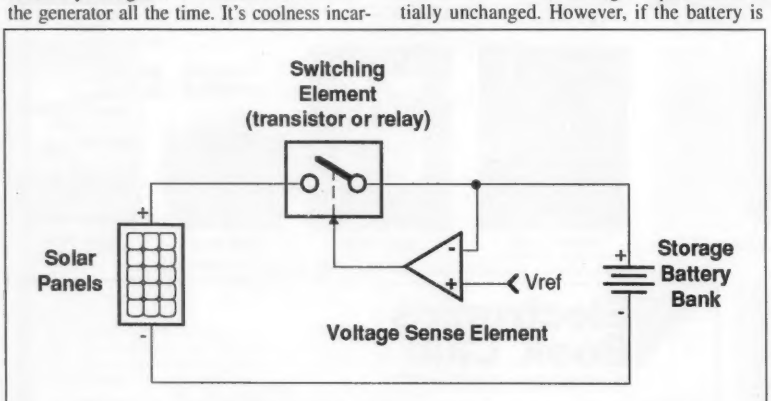

Figure 1. Series control scheme.

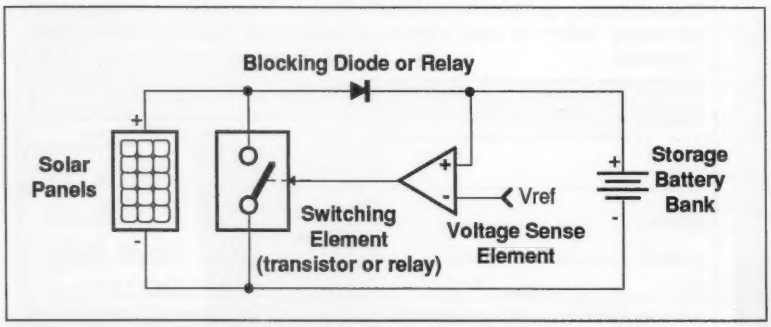

Figure 2. Shunt control scheme.

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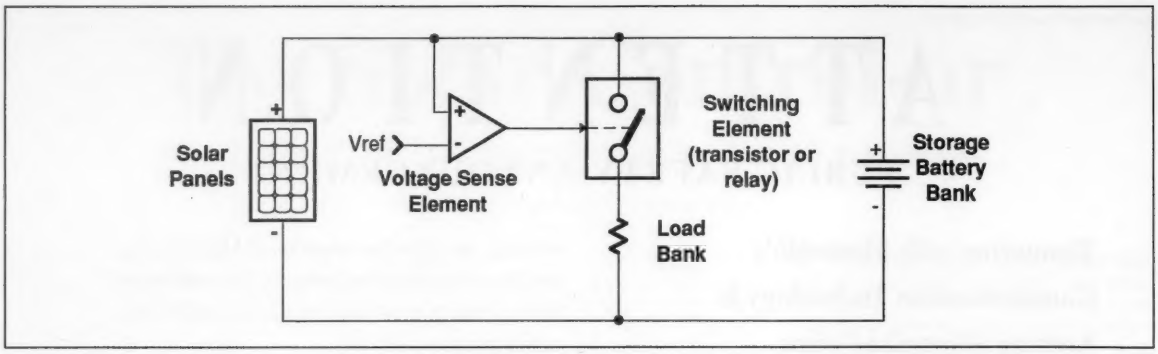

Figure 3. Diversion control scheme.

Series Control Scheme

In my survey of what's already out there, I found that one of three different techniques may be used in the typical charge controller to limit the solar panel's output upon completion of battery charge. Each technique has its own advantages and disadvantages.

See Figure 1. *The series-regulated* approach uses a switch in series (surprise!) with the solar panel output to disconnect the solar panels from the batteries as soon as the desired level of charge is reached. The biggest advantage of this scheme is probably its simplicity. As with the other approaches, the actual switch may be a relay contact, or one or more power transistors. The relay-types cycle on and off at long intervals (from several minutes to several hours, typically), while designs that use power transistors may cycle at rates up to several tens of kHz, à la Pulse Width Modulation.

Shunt Control Scheme

The *shunt-regulated* approach shorts out the solar panels as soon as the batteries are charged. Solar panels, being essentially constant-current sources, are in no manner harmed by being shorted indefinitely. The output voltage just drops to almost nothing as the current increases only very slightly above its normal value. With a really low-impedance shunt switch, the shorted-out power dissipation can be held to very low levels. Note that a blocking diode or secondary switch is used in conjunction with the shunt switch in order to avoid also shorting out the connected batteries (definitely something to avoid!). Although the additional diode or switch complicates this approach somewhat, it still has the advantage of being a relatively simple scheme to implement.

Diversion Control Scheme

Unlike the previous techniques, the diversion-regulated approach doesn't attempt to prevent energy from reaching the battery as it reaches full charge, but instead siphons off excess energy so as to maintain the desired battery voltage. As the batteries top off, the controller automatically switches a load bank across them, so as to keep the voltage from

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Table 1. Meter shunt details (see text).

climbing any higher. As the load bank starts to overwhelm the output from the solar panels, the battery voltage begins to drop, eventually reaching a point at which the load bank is automatically disconnected. This connection-disconnection process continues as long as the solar panels are producing a surplus of power, thereby preventing overcharge. A big advantage of these controllers is that they don't care what sort of power source is actually doing the battery charging; all they are concerned with is keeping the battery voltage from exceeding a set value. This makes them useful in situations where solar battery charging is supplemented by other charging sources (like wind chargers or water turbines). No matter how many different charging sources you add to a battery bank, just one diversion regulator will control them all, as long as the combined current output from all sources does not exceed that of the regulator or the load bank attached to it. The biggest disadvantage of this scheme is probably the load bank requirement, which forces you to figure out what you are going to do with any surplus power produced by the system.

One nice thing about all three of these techniques is that once the batteries have reached a state of complete charge, the excess solar energy does not necessarily have to be discarded but can be instead used to power other lower-priority loads. In the case of the series and shunt regulation schemes, all you have to do is substitute a power diversion switch for the existing disconnecting or shorting switch. For diversion regulation systems you just connect your alternate load in place of the controller's load bank. Any electrical load will suffice, so long as it is tolerant of frequent disconnects from power. In the case of diversion regulation, the load must also be ever-present, and must be large enough to be capable of swamping the output of the solar panels on even the sunniest of days. Good potential candidates for load banks would include water pumps (you can always stand a little more water in the stock tank as soon as the batteries finish charging), cooling fans (keep the wife and the chicken coop cool) and, in larger solar installations, hot water pre-heating or electrical generation of hydrogen gas (for later use as a fuel).

Note that all three of these regulation techniques are typically implemented with saturated on-off switching. Theoretically, you could incrementally adjust the amount of voltage or current being produced by your panels as the battery charge increased, using pass transistors biased in a linear mode. The biggest practical disadvantage to this technique probably lies in the tremendous amount of heat that would be generated by the pass transistors at any point between saturation and full cut-off. All that heat would have to be dissipated somewhere, and at the very least would result in increased size and cost, due to a rather herky heat sink! So, linear regulation is probably not as well suited to the constant-current nature of solar cells as it is to power sources with essentially unlimited supply currents (like batteries and AC mains). The sole

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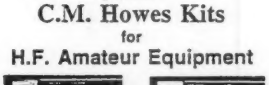

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CIRCLE 36 ON READER SERVICE CARD

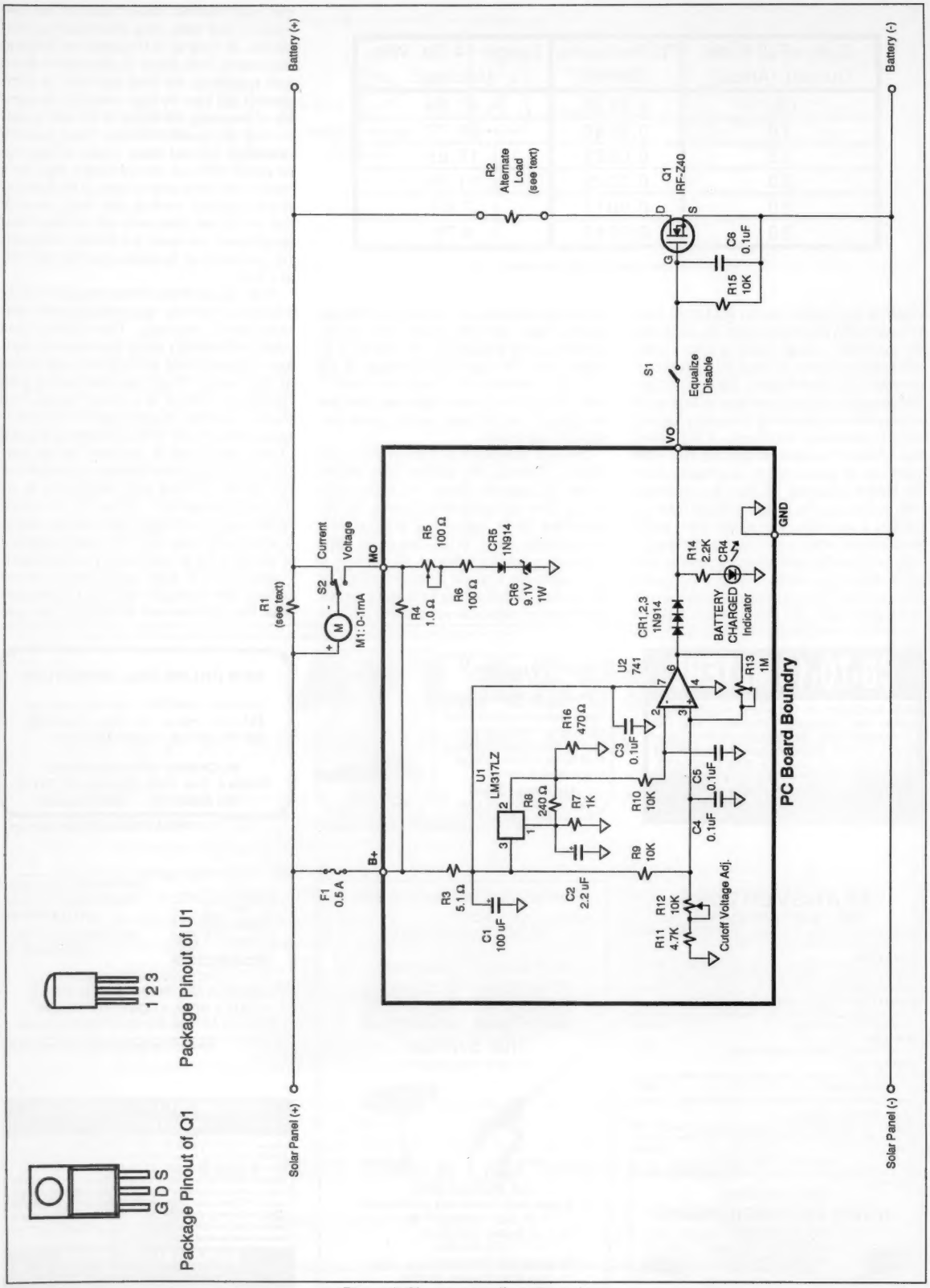

Figure 4. Charge controller schematic.

exception might be in controllers for very small solar arrays, where heat dissipation could be more easily managed.

Anyway, this survey provided a good starting point for my own design. For the switching element, I considered using relays, power BJTs, and power FETs. A power relay looked good from a cost standpoint (you can buy a fog lamp relay at Wal-Mart for less than $4, and you don't need a heat sink), but the reliability of the contacts would always be suspect. High power FETS are easier to use than BJTs, and are very reasonably priced, so they looked like the best choice. As for the actual circuit configuration, I considered several factors important.

First, the use of a transistor in a series switch arrangement would mean that some power would be wasted in the voltage drop across the transistor when the battery was being charged. This would reduce the efficiency of the charge controller somewhat. Likewise, the use of a shunt switch arrangement would mean that some power would be wasted in the voltage drop across the blocking diode.

Second, the power being dissipated across these components (in either configuration) is significant for rather long periods of time (whenever the sun is shining and the batteries are not fully charged), which could shorten their life expectancy. A diversion regulation scheme avoids these two problems because no switching or blocking device is employed between the solar panels and the batteries, and the diversion load switching device is only operated for brief periods *after* the battery has reached full charge. This implies good efficiency and reliability. Since no blocking diode or series switch is used, there will be some loss of efficiency with this arrangement, due to nighttime solar panel reverse leakage current (typically 15 mA per 50 watt panel), but this is more than offset by the higher daytime efficiency. So there you have it—an FET-switched diversion regulator it is!

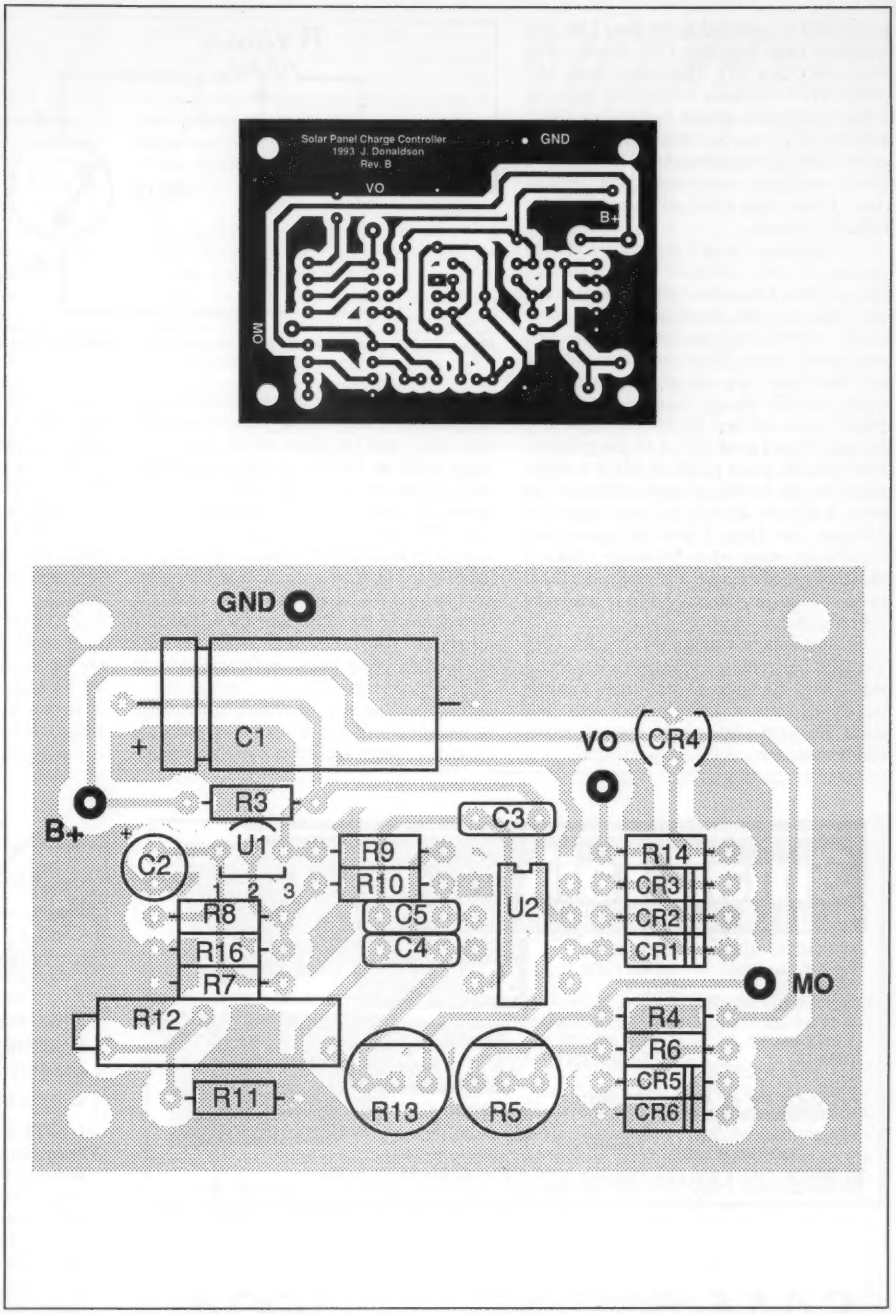

Figure 5. PC board foil pattern (100%) and parts placement diagram (200%).

From that point on, the design was pretty straightforward. In referring to the schematic, you'll see that U2 compares the battery voltage with a reference developed by U1, and turns on Q1 as soon as the battery voltage exceeds the level set with R12. Q1 in turn grounds the alternate load (R2), which swamps the output current being produced by the solar panels. Note that since the LM317LZ can't regulate a voltage that approaches its input value (e.g., the battery voltage), it is instead set to a lower reference voltage (approximately 6.5 volts). The R9/R11/R12 pair scale the battery voltage down to a value roughly comparable to this reference. Since the 741 is incapable of output voltage swings completely to ground, CR1, CR2 and CR3 are used to prevent the volt or so of output normally present at U2 from keeping Q1 turned on. In order to easily fine-tune the charge cutoff voltage and to improve the controller's resistance to mechanical vibration, a multi-turn trimmer is used for R12 (10 to 15 turns works nicely). The voltage difference between termination and resumption of battery charging (e.g., the charger's hysterisis) is adjustable via pot R13.

In addition to driving Q1, U1 also directly drives the "BATTERY CHARGED" indicator LED. Note that unlike some other charge controller designs, this LED is not lit until *after* the battery reaches full charge.

A single International Rectifier 50 amp

power FET is specified in the Parts List; it is available from Digi-Key (701 Brooks Ave. South, P.O. Box 677, Thief River Falls MN 56701-0677; telephone 1-800-DIGI-KEY for a free catalog) for around four dollars. Other smaller FETs can be substituted for lower power handling requirements, or several FETs can be paralleled in extremely large installations. I like using a well-oversized FET, for reliability reasons.

The metering circuit I chose measures the amount of current produced by the solar panels, and also determines battery voltage. The vast majority of the charging current is borne by R1, while a small portion of it is diverted through the meter. Since the meter uses a 1 mA movement, the voltage drop across R1 never exceeds 50 mV, thereby minimizing power losses and heat dissipation. Physically, R2 consists of a small coil of 14-gauge household wire, the exact length of which is determined by the desired full-scale reading of the meter. I set mine up for a full-scale current of 14 amps, but Table 1 lists the appropriate lengths for some other full-scale values. I chose 14-gauge because it is readily available in most hardware stores. Solid is preferred over stranded.

To read battery voltage, R4, R5, R6, CR5 and CR6 are used in a voltage-scaling circuit that allows the meter to read from approximately 10 volts no-scale to 16.5 volts full-scale. The expanded voltage scale is important because there is typically less than 1 volt of difference between the output of a fully-charged and a fully-discharged lead-acid battery. Any small variations within that 1 volt range would be difficult to read on an analog meter, unless the meter scale was expanded to remove the useless 0 to 10 volt range of readings. (Whether your battery reads 10 volts or something less than 10 volts is immaterial; in either case you have a damn dead battery on your hands!) On the top end of the scale, the normal charge-cutoff voltage for a lead-acid battery can range as high as 14.8 volts, with equalization being safely performed at up to 16.5 volts (see the sidebar on battery charging). This value sets the desired upper range of measurement. For temperature stability, current is always applied to CR6. This represents a small continuous battery load (less than 20 mA under most conditions), but buys some improvement in meter accuracy.

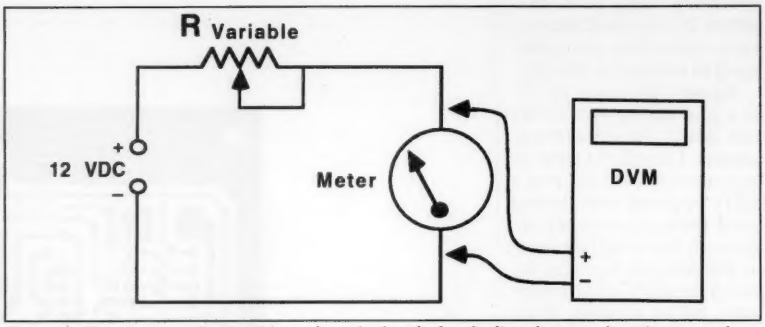

Figure 6. The precise value for R1 can be calculated after finding the meter's resistance value.

For ease of construction, a printed circuit board layout has been provided. Almost all of the components carrying low currents mount on it, while the components requiring heavy-gauge wire mount in what ever type of enclosure you desire. I mounted mine in a wall paneling cutout, using the aluminum cover from a bakelite experimenter's box as the front panel. These covers are available without the rest of the box from Digi-Key for under $2. Make sure that the PC board is mounted so that R12 and R13 can be easily adjusted with everything buttoned together.

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in your installation, R2 can consist of 12 volt light bulbs (headlamps for high current applications; #1141 bulbs for smaller installations), or power resistors. I recommend that the load be spread among several individual resistors or bulbs so that if one burns out, the controller will still function (although at some reduction in overcharge protection). Also, if bulbs are used, be sure to pick a bulb with long life (e.g., 1,000 hours for the #1141, versus only 200 hours for the similar-appearing #1156 bulb). Using 24 volt bulbs in a 12 volt system will also greatly extend reliability, although more bulbs will be required. High-power load resistors can be easily built from scratch with nichrome heating wire (available at most hardware stores), and mounted in ventilated metal boxes, tin cans, etc.

To calibrate the meter for battery voltage, set R5 and R13 at the middle of their ranges, and switch S2 to the voltage scale. Disconnect any alternate load. Apply +10 VDC to the battery terminals and allow CR6 to warm up for a few minutes before proceeding. Adjust R5 to just below the point at which some meter deflection starts to occur. Gradually increase the voltage at the battery terminals, noting and recording the resulting meter readings. (These readings can be used later in relabeling the meter face, if desired). As you increase the voltage, verify that the meter pegs out at a little over 16.5 volts of input. Next, set the input voltage to the desired battery charge cut-off value, and adjust R12 until the BATTERY CHARGED indicator lights up. There are no adjustments for calibrating the current scale; the current readings can be read off an ammeter connected in series with the positive battery wire, once the controller is installed and hooked up to the panels and batteries. Again, the current readings can be recorded for later use in relabeling the meter face.

During installation, I recommend providing fusing between the charge controller and the batteries, located as close to the batteries as possible. In some larger solar installations, you might want to consider remote-mounting the meter and PC board, if it will save you any appreciable length of heavy-gauge (bulky and expensive!) wire. If going that route, simply mount the PC board, S1, S2, F1, and the meter in a box located for viewing convenience, and mount everything else somewhere directly between the solar panels and the batteries. Small-gauge wiring (e.g., telephone cable) can then be used to connect the two boxes.

After the controller has been installed, readjust R12 for proper charge cut-off voltage. The difference between charge cut-off and turn-on voltage is set with R13, and will vary with battery size and loading. Normally, R13 should be adjusted so that CR4 does not cycle more than several times a second under light battery loads, but should never fail to resume charging when battery voltage drops below approximately 13 volts. There is some interaction between the settings for R12 and R13, so several readjustments may be necessary to get the desired charge cut-off and resumption voltages.

The controller is heavily bypassed for RF interference rejection. For best RF rejection, it is suggested that separate wiring be used to connect the radio(s) to the batteries. A metal enclosure for the controller also helps and, finally, a 100 µH RF choke can be added in series with the fuseholder in particularly stubborn situations.

If you have access to a computer, laser printer, and drawing or drafting software, you can relabel the meter face in a very professional manner. First, recreate the physical dimensions and markings of the old meter face with your drawing program. Next, substitute your recorded voltage and current readings for those of the existing meter face, in the corresponding positions on the meter scale. Finally, use your laser printer to print the new meter face on large adhesive-backed label paper (Avery 5165 or equivalent), and stick the new face over the old one. Very spiffed!

In conclusion, I think you'll find that this controller is the best battery banger for your buck. It's efficient, reliable, and has all the useful tweaks. Whether you're building a mansion in the middle of nowhere, sticking a TNC on top of the local mole hill, or just need a little something to keep your Argonaut's trolling motor battery from boiling dry, this little baby will do the job.

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A Few Words About Batteries

While most other components in an alternate energy system are virtually indestructable and maintenance-free (with the possible exception of wind chargers and water turbines), the selection and maintenance of electric storage batteries can make or break the entire installation. Make your battery selection carefully and maintain it properly and it will serve you well for years. Make the wrong choice or neglect your investment and you will soon have another opportunity to make a wiser battery purchase!

Storage batteries used in most solar power applications are either lead-acid or NiCd. Lead-acid batteries can be cheaply purchased new almost anywhere, while NiCd cells are generally available only as surplus. The big advantages lead-acid cells have over NiCds are that they are more efficient to recharge (only 15 to 20 percent of the charging energy is lost, as compared to 25 to 35 percent for NiCds), they offer better voltage regulation under load, and they are usually cheaper than surplus NiCds. On the other hand, NiCds are much more tolerant of extreme discharges, and are not as prone to permanent damage due to repeated undercharge or long-term storage in a discharged state. Since the vast majority of solar installations use lead-acid batteries, most the following information will center around them.

Some Battery Basics

The lead-acid battery types that are most common in solar applications are all of deep-cycle design. This is significant, because a deep-cycle design stands up to repeated heavy discharge-recharge usage much better than a battery of ordinary automotive design does. An automotive battery is designed to deliver very large bursts of current for short periods (when starting a car), and then is immediately recharged (by the car's alternator). Most solar power applications require the battery to provide lesser amounts of current, but provide it for extended lengths of time before receiving any recharge. An automotive battery will lose a significant percentage of its full storage capacity after being heavily discharged just one time. It will typically lose 50 percent of its capacity after 20 such discharge-recharge cycles. (For our purposes, a heavy discharge is one that removes all but 20 percent of the battery's original full charge). By contrast, even the lightest duty deep-cycle battery will typically tolerate 200 to 300 such discharge-recharge cycles before reaching a similar state; some of the heavier deep-cycle designs can exceed 10,000 such cycles. It is a common mistake to purchase the "biggest batteries you can get" for a new solar installation, usually meaning size 4D or 8D truck/tractor batteries (which are conventional automotive designs). Regardless of how "heavy duty" a battery is claimed to be, if it isn't a deep-cycle design, it won't last very long in most solar applications.

The maximum storage capacity of a deep-cycle lead-acid battery is usually specified either in amp-hours or in minutes of reserve capacity. The amp-hour value refers to the number of amps a battery will deliver over a specified period of time (generally implied to be 20 hours, if not specifically stated), before the battery has discharged to a useless level (around 10.5 volts). The reserve capacity value specifies the number of continuous minutes the battery can last while delivering 25 amps, before dropping to this same 10.5 volts. As a rule of thumb, for the smaller batteries, you can multiply the number of reserve minutes directly by 0.6 to arrive at an approximate equivalent amp-hour rating for the battery. Therefore, a 50 amp-hour battery (or a battery with approximately 83 minutes of reserve capacity) can be expected to deliver at least 2.5 amps for 20 continuous hours, or at least 1 amp for 50 continuous hours. Note, however, that at current drains much higher than those specified at the 20 hour rate the capacity of the battery starts to decline due to internal losses and chemical inefficiencies at high currents. Consequently, this same battery might only be able to deliver 5 amps for nine hours (45 effective amp-hours), instead of the 10 hours (50 theoretical amp-hours) implied by the battery's amp-hour rating. Bigger batteries can deliver higher currents without incurring this effect.

Like all lead-acid batteries, the life expectancy of a deep-cycle battery is directly dependent upon how heavily the battery is discharged before being recharged. Batteries that are routinely discharged to only 20 percent of their rated capacity have a much shorter life expectancy than identical batteries that are rarely discharged below 50 percent. This same trend applies at the extremes—few batteries that are completely discharged will last for more than a few such cycles, and most batteries that are never discharged below 80 to 90 percent of their capacity will last almost indefinitely (given proper maintenance). The moral: Don't buy a 100 amp-hour battery if you are planning on routinely using all 100 amp-hours between recharges. A good rule of thumb states that a deep-cycle battery should be recharged before 80 percent of the capacity has been drained, with 50 percent being even better. Fifty percent discharge represents a good compromise between battery life expectancy and reasonable battery bank size. Therefore, you would do well to buy at least 200 amp-hours worth of batteries to meet your anticipated 100 amp-hour discharge "budget."

Ambient temperature also has a strong effect on battery performance. Most batteries are rated at around 80 degrees Fahrenheit. At higher temperatures they are capable of greater capacity, but their life span is shortened, due to the acceleration of detrimental chemical reactions. At lower temperatures, they last longer than normal (provided the electrolyte is not allowed to freeze), but their capacity drops. At 32 degrees F, typical capacity is reduced by 35 percent; at 0 degrees F, it is reduced by 60 percent; and at minus 20 degrees F,

	Charge Cutoff Voltage:	Maintenance Voltage:	Equalization Voltage:
Wet-Cell Battery @ 80° F.	14.4	13.5	16.3
Wet-Cell Battery @ 100°F.	13.9	13.3	15.8
Gel-Cell Battery @ 80° F.	14.4	13.8	(na)
Gel-Cell Battery @ 100° F.	14.1	13.8	(na)

Table 2. Non-sealed wet cell battery states.

Approx. State of Charge:	Specific Gravity:	No-Load Voltage:
100%	1.270	12.70
75%	1.250	12.50
50%	1.190	12.30
25%	1.150	12.10
DEAD!	1.120	11.80

Table 3. Suggested charge and equalization voltages for various batteries.

it is reduced by better than 80 percent. Their ability to accept a charge also drops along with the thermometer. In general, the best tradeoff between efficiency and long life occurs when the battery is maintained at around room temperature.

As a battery is discharged, the sulfuric acid solution inside each cell is gradually converted to ordinary water. Consequently, the specific gravity of this solution also drops as the battery discharges; this change can be easily measured with a hydrometer in order to determine the battery's state of charge. A good battery hydrometer includes a temperature correction scale (specific gravity versus battery charge varies somewhat with temperature), and will often provide readings that are more precise than those obtained with a voltmeter. Specific gravity readings should be taken by inserting the hydrometer suction pipe into the battery cell, squirting the electrolyte into and out of the hydrometer several times (electrolyte agitation improves accuracy), and then reading the hydrometer while the suction tube is still inserted into the cell. Keeping the suction tube in the cell while taking readings minimizes the chance of spilling the electrolyte on feet, kneecaps, or any other exposed appendages. Read the hydrometer scale at the center of the fluid inside the tube, not at the edges. Note that any heavy battery charge or discharge currents drawn just prior to taking specific gravity or voltage measurements will have an adverse effect on the accuracy of the readings. Specific gravity readings are also helpful in determining the overall health of a battery. For example, differences in specific gravity of more than 0.050 between any two individual cells in a battery generally indicate that the battery is headed for problems. By taking specific gravity readings every month or so you can catch battery problems before they cripple the entire system.

Table 2 is helpful in determining the state of charge of a battery, using either a voltmeter or hydrometer. Note that this table is applicable only to the non-sealed wet-electrolyte batteries. For obvious reasons, a hydrometer should never be used on a sealed battery (wet or gell).

What To Buy

Among the deep-cycle variants, the most common type is the RV/Marine, typically sold by hardware and department stores in automotive package (or "group") sizes 24 and 27. Typical ratings for this class of battery are 70 amp-hours (110 minutes) for the size 24, and 105 amp-hours (170 minutes) for the size 27. These batteries represent a reasonable value in smaller solar systems, or in installations where space is at a premium. However, as deep-cycle designs go, they are lightweights, with relatively short life expectancy in heavy service. This deficiency is primarily due to the use of thin lead plates used in their construction, and the low antimony content of the plates themselves. The next most common deep-cycle version is probably the golf cart/electric vehicle, typically sold through battery supply houses, some wholesale clubs, and an occasional department store (frequently by catalog only). These batteries are all of 6 volt design (you use two in series to get 12 volt banks), and typically cost a tad more per pair than a single size 27 RV/Marine battery. They provide superior service in most solar applications (due to thicker plates and higher antimony content), and probably represent the best value for small to mid-sized installations. Typical ratings are 220 amp-hours, or 400 minutes of reserve capacity.

Industrial (floor scrubber) batteries are probably best described as golf cart batteries on steroids. They are 6 volt, with much taller cases than golf cart batteries. They are typically rated at around 350 amp-hours, and they also make excellent choices for small-to-mid-sized solar applications. They are available from the larger battery supply houses, or may be special-ordered (along with ordinary golf cart batteries) from auto parts stores like NAPA. High-quality deep-cycle batteries for marine applications are manufactured by Surrette and by Rolls, in a variety of sizes. They are of very heavy construction, with very thick, high antimony content plates. Many marine supply houses stock them, and they work very well in solar applications.

For non-mobile installations, really large deep-cycle batteries are often employed. For example, 12 volt electric fork lift batteries are available with typical ratings of 1,000 amp-hours. Life expectancy is around 10 years, and the cost brand-new is under $2,000. Surplus telephone cells are also popular, with ratings of 1,200 to 2,500 amp-hours being commonplace. These cells are sold individually (each cell is 2 volts and weighs between 300 and 500 pounds). Life expectancy is greater than 20 years for new ones.

A good used set will have at least 10 years of life left in it, and is available for around $400 to $800 per 12 volt group. Gell-electrolyte (gell-cell) batteries are becoming cheaper and more popular for solar applications. Available in group 24, 27, 4D, 8D and 6 volt golf cart sizes, they offer very good performance, with virtually zero maintenance. Where ordinary "wet cell" batteries require monthly checks of electrolyte levels, the gel cells are completely sealed, with nothing to replenish. They also offer higher charging efficiency than ordinary batteries, and provide slightly higher output voltage down to complete discharge. Examples of this class of battery are the Johnson Dynasty, Exide Nautilus Megacycle, and Dryfit Prevailer/Sonnenschein/ Deka brands. Don't confuse these batteries with the "maintenance-free" wet-electrolyte RV/Marine batteries being sold in some department stores under brand names such as Delco Voyager and GNB Stowaway. Unlike the true gel-cells, these batteries offer little improvement in performance over the standard RV/Marine models.

How To Keep Them Happy

Although routinely overlooked in the battery manufacturers' literature and in many references, most deep-cycle batteries (with the exception of the gell cell and other totally-sealed varieties) are benefited by a periodic, controlled overcharge, often referred to as an equalization charge. To equalize a battery, the charging is allowed to continue for some time past the point at which the battery is normally considered to be "full," taking care to avoid excessive battery heating or electrolyte boil-off. In a typical equalization cycle, the battery voltage is allowed to rise to approximately 16 volts, where it is maintained for up to eight hours by adjustment of the charging current. This process helps to mix up the electrolyte, which otherwise tends to "stratify" (e.g., separate into overlapping layers of acid and water). It is also useful in removing some sulfate deposits. When performed properly, equalization doesn't make the battery boil over, but does produce fairly vigorous bubbling. At the termination of this cycle you can expect to add some water. Most battery manufacturers consider one equalization charge a month to be appropriate for batteries that are in a continuous state of charge and discharge; less often is adequate for batteries that see a lot of standby service. Due to the generation of considerable gas that accompanies this process, equalization should *never* be performed on a sealed or gell-electrolyte battery. (Because their electrolyte is gelled, stratification is generally not a problem with gell-cells, anyway). Also, most 12 volt appliances will not tolerate 16-plus volts, so remember to disconnect everything before you equalize. Table 3 summarizes the suggested charge and equalization voltages for various batteries.

Finally, remember that lead-acid batteries generate highly explosive gasses. The larger the battery bank, the more gas produced. Don't mount any battery in an unvented location, and avoid any sparks or open flame around the battery (particularly during and shortly after recharging). Making or breaking electrical connections at the battery terminals is particularly dangerous. Battery explosions often shower large areas with acid. Wear eye, face and skin protection, and give the bank plenty of time to "air out" before attempting any maintenance or inspection.

The Solar Control-ar

And a Few More Words About Solar Panels

If you are buying new solar panels, you will probably find that models in the 47 to 65 watt range represent the best value (e.g., most watts per dollar), if that size range will serve your needs without overkill. This range is where the sales volume currently lies for large-scale power production (e.g., for homes and small businesses). Excellent quality is the rule throughout the industry, with limited warrantees typically ranging from 10 to 12 years. Actual expected life is anyone's guess, but figures of 20 to 30 years are routinely tossed around. There isn't too much standardization in panel sizes among the offerings from different manufacturers, so pick your brand and mounting hardware carefully. Also, the power density (amount of power produced per square inch of panel area) varies subtly from one model and manufacturer to the next. This means that in some applications where space is very limited, Model X might meet performance objectives where Model Y wouldn't. In picking a panel model, you should consider the anticipated temperature operating range of the panels, the efficiency of your charge controller, and your battery maintenance requirements. As the temperature of a solar panel rises, its output voltage drops. If your panels will be located in a very hot climate and/or are mounted in such a manner as to hinder air circulation around both surfaces, you should limit your panel selection to models that offer the highest charging voltages (typically around 17 volts at rated output current). Some of the lower-voltage "self-regulating" panels are designed to be used without a charge controller in applications where the load attached to the battery is anticipated to be constant enough to avoid boiling dry the electrolyte. Since the output voltage of these panels has been intentionally reduced, the likelihood of battery damage is small. Unfortunately, so is the likelihood of ever fully recharging the battery. High temperature becomes even more important if you will be periodically equalizing your batteries, since this process can require better than 16 volts under full load from the panels.

Finally, if the output voltage of your panels is marginal under hot conditions, a charge controller with excessive internal losses may aggravate the problem. Try to pick a controller that has less than 0.5 volts of drop under your maximum anticipated charge current (the controller described in the accompanying article has virtually no internal losses). If you will be buying your panels surplus, you are pretty much stuck with what's available. If possible, obtain permission to return the panels for a refund if an initial test shows that they are producing considerably less than their new rated current and voltage. Look for water leaks in the seams of the panel glass. If the panel has

Continued on page 38

Parts List

Resistors (1/4 watt 5% unless otherwise stated)
R1=Meter Shunt (see text and note below)
R2=Alternate Load (see text)
R3=5.1 ohms
R4=1 ohm
R5=100 ohm single-turn, linear taper trim pot. Bourns series #3323W or series #3362U. Available through Digi-Key.
R6=100 ohm
R7=1K
R8=240 ohm
R9=10K
R10=10K
R11=4.7K
R12=10K multiple-turn linear taper trim pot. Bourns series #3006P or Spectrol series #43P. Available thouugh Digi-Key.
R13=1M single-turn linear taper trim pot. Bourns series #3323W or series #3362U. Available thouugh Digi-Key.
R14=2.2K
R15=10K
R16=470 ohm
Capacitors
C1=100µF 25V electrolytic
C2=2.2µF 16V electrolytic
C3=0.1µF ceramic disk
C4=0.1µF ceramic disk
C5=0.1µF ceramic disk
C6=0.1µF ceramic disk
Semiconductors
CR1,2,3,5=1N914 small signal Diodes
CR4=LED
CR6=9.1v, 1w Zener diode
Q1=IRF-Z40 50 amp power MOSFET
U1=LM317LZ 3-terminal adjustable regulator
U2=741 single op-amp
Meter
M1=0-1mA
Switches
S1=SPST
S2=SPDT
Fuse
F1=0.5A
Miscellaneous
heat sink
enclosure
fuse holder

Drilled and etched PC boards are available for $3.50 plus $1.50 S&H from FAR Circuits, 18N640 Field Ct., Dundee IL 60118.

Note (Calculating R1): Due to the large amount of current and very low resistance value of R1, this resistor is best built from scratch. R1 is an ammeter current shunt, and physically consists of nothing more than a precise length of 14 gauge household wire. The proper wire length is shown in Table 1. There is nothing unusual about building it—it can be wrapped in a coil, wadded-up, or just left hanging. As shown in the schematic, meter M1 is connected through it with a couple of ordinary hook-up wires. Since the vast majority of current is carried through R1, the wires to the meter can be of most any convenient gauge.

The value for R1 can be determined after the decision is made on maximum current through shunt load R2 and the full scale meter movement current and meter resistance. All current meters have some small value of resistance. If you don't know that value, you can calculate it with a simple experiment:

Let I_M = full scale meter movement current
R_1 = meter shunt resistance
I_1 = maximum load current into the shunt R_2
R_M = resistance of the current meter
Take a variable resistor that has a value of 2 X 12 volts/I_M.
If the I_M current is 1 mA, then the variable resistor should be greater than 12 kΩ or approximately 30 kΩ. Connect the meter and variable resistor (*adjusted to maximum resistance*) as shown in Figure 6. Slowly adjust the resistor until the meter is reading full scale (1 mA in this example). Now measure the very small voltage drop across the meter with a DVM. This voltage drop divided by the full-scale current meter reading will be the meter resistance R_M.
Now the value of R1, the shunt resistor, can be determined for the full scale current meter with the calculated meter resistance of R_M:

$$R1 = \frac{I_M}{I_1} R_M.$$

JRC

JRL-2000F

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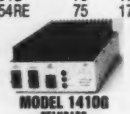
RF POWER AMPLIFIERS

NEW! 400 WATTS AVG. (144-148 MHz)

Model	Pin (W)	Pout (W)	Ic (A)	Gain/NF (dB)	(13.8 V) Type
50 MHz					
0503G	1-5	10-50	6	15/0.6	LPA
0508G	1	170	28	15/0.6	Standard
0508R	1	170	28	–/–	Repeater
0510G	10	170	25	15/0.6	Standard
0510R	10	170	25	–/–	Repeater
0550G	5-10	375	60	15/0.6	HPA
0550RH	5-10	375	60	–/–	Repeater HPA
0552G	25-40	375	55	15/0.6	HPA
0552RH	25-40	375	55	–/–	Repeater HPA
144 MHz					
1403G	1-5	10-50	6	15/0.6	LPA
1406G	25	100	12	15/0.6	Standard
1409G	2	150	25	15/0.6	Standard
1409R	2	150	24	–/–	Repeater
1410G	10	160	25	15/0.6	Standard
1410R	10	160	24	–/–	Repeater
1412G	25-45	160	20	15/0.6	Standard
1412R	25-45	160	19	–/–	Repeater
1450G	5	350	56	15/0.6	HPA
1450RH	5	350	56	–/–	Repeater HPA
1452G	25	350	50	15/0.6	HPA
1452RH	25	350	50	–/–	Repeater HPA
1454G	50-100	350	40	15/0.6	HPA
1454RH	50-100	350	40	–/–	Repeater HPA
220 MHz					
2203G	1-5	10-40	6	14/0.7	LPA
2210G	10	130	20	14/0.7	Standard
2210R	10	130	19	–/–	Repeater
2212G	30	130	16	14/0.7	Standard
2212R	30	130	15	–/–	Repeater
2250G	5	220	40	14/0.7	HPA
2250RH	5	250	40	–/–	Repeater HPA
2252G	25	220	36	14/0.7	HPA
2252RH	25	250	36	–/–	Repeater HPA
2254G	75	220	32	14/07	HPA
2254RH	75	250	32	–/–	Repeater HPA
440 MHz					
4403G	1-5	7-25	4	12/1.1	LPA
4410G	10	100	19	12/1.1	Standard
4410R	10	100	18	–/–	Repeater
4412G	20-30	100	19	12/1.1	Standard
4412R	20-30	100	18	–/–	Repeater
4448G	5	100	22	12/1.1	HPA
4448R	5	100	22	–/–	Repeater HPA
4450G	5-10	175	34	12/1.1	HPA
4450RE	5-10	175	34	–/–	Repeater HPA
4452G	25	175	29	12/1.1	HPA
4452RE	25	175	29	–/–	Repeater HPA
4454G	75	175	25	12/1.1	HPA
4454RE	75	175	25	–/–	Repeater HPA



MODEL 1410G STANDARD

MODEL 1450G HPA

All amplifiers (non-rptr) are linear, all-mode with fully automatic T/R switching and PTT capability. The receive preamps use GaAs FET devices rated at .5 dB NF with +18 dBm 3rd order IP. LPA, Standard and HPA amps are intermittent duty design suitable for base and mobile operation. Repeater amps are continuous duty, class C.

Amplifier capabilities: High-power, narrow or wideband; 100-200 MHz, 225-400 MHz, 1-2 GHz, Military (28V), Commercial, etc. – consult factory. A complete line of Rx preamps also available.

RX Preamplifiers

Band	Model	NF (dB)	Gain (dB)	Connector
50 MHz	0520B	.5	25	BNC
50 MHz	0520N	.5	25	N
144 MHz	1420B	.5	24	BNC
144 MHz	1420N	.5	24	N
220 MHz	2220B	.5	22	BNC
220 MHz	2220N	.5	22	N
440 MHz	4420B	.5	18	GNC
440 MHz	4420N	.5	18	N
1.2 GHz	1020B	.9	14	BNC
1.2 GHz	1020N	.9	14	N

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The Solar Control-ar

Continued from page 36

bare wires for electrical connections, wiggle the wires while checking the output under load to insure that the panel connections are not intermittent. A panel with faulty connections will often show sufficient output voltage under no load, but will drop to almost no output when any appreciable current is drawn. Beware of stolen panels. Some bargain panels being sold at flea markets were originally "liberated" from mountaintop radio sites or RV'ers in the desert. If the panels are engraved or otherwise marked, make sure that the seller has a believable story as to their ancestry. Take names and addresses.

In most installations, you have a choice between tracking the sun with the panels, or leaving the panels in a fixed position for the day. Auto-tracking panel mounts are commercially available (or can be fun to design and build yourself), but they do add some expense and maintenance requirements to the system. If the size of your system is marginal, buying additional fixed panels might be just as cost-effective as installing trackers. During the wintertime, much of the advantage in tracking the sun is lost, since it never rises very far above the horizon, and doesn't travel very far horizontally between sunrise and sunset. Also, on overcast days, it makes little difference which direction the panels are facing, but installing additional panels will always provide some additional output. However, if you don't use a tracking system, be sure to include provision for seasonally changing the elevation of the panels. An adjustable bracket costs little more than a fixed mount, and the improvement in power output is almost always significant.

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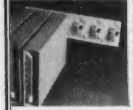

The 6-port **NETRIX** Diode Matrix Board connects TNCs together to form a network switching node, where packets are routed towards their final destination. It uses DE-9F connectors, is designed to eliminate expensive, unsightly cables, and works with either TheNET or ROSE networking software. $24.95 as a complete kit, or $39.95 assembled. Adapters for DRSI, MFJ or AEA TNCs are only $2.49 each - specify TNC model.

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by Peter Putman KT2B

Ramsey Electronics FX-146 Transceiver Kit

Roll your own 2 meter rig.

Ramsey Electronics
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Telephone: (716) 924-4560
Price Class: $149.95 without chassis/knob kit;
$24.95 for matching CX chassis/knob kit.

Okay, you're a typical ham and like to fire up the ol' soldering iron once in awhile. Let's say you just found $175 stashed away for a rainy day or the next trip to the Dayton Hamvention. (Sometimes they are one and the same!) What would you buy? Let's see, how about a 4 watt, diode-programmable, packet-ready 2 meter synthesized transceiver kit? And it has to have a snazzy-looking cabinet kit with knobs. Wait, it should also be able to work with virtually any speaker/mike on the market! And the receiver coverage should be broadband to pick up NOA weather signals.

Kinda picky, aren't you? Good thing that John Ramsey of Ramsey Electronics thinks the same way you do, and makes the FX-146 transceiver kit!

Overview

Yes, the FX146 is a pretty neat piece of work, and a proud successor to the original FTR-146 kit, introduced in 1991. For your money, you get a state-of-the-art radio with a professionally-screened G10 circuit board that's easy to put together, easy to test, and works very well on the air. Bells and whistles have been kept to a minimum, with the emphasis on a well-thought-out design employing the Motorola 145152 phase-lock-loop synthesizer chip and your everyday, garden variety 1N914 diode for frequency selection (see Photo C).

The concept behind this radio is simple, but clever: Build your own 2 meter radio, and while you do you'll learn how all of the parts and circuitry work. Should repairs be required, you won't hesitate to open the cover and "dive in" to fix it. What's more, you'll take more pride in this radio precisely because *you built it yourself.* (And, of course, let's not forget that you saved a few dollars along the way!)

I bought my FX-146 at Dayton '93 strictly on impulse—it was, after all, a rainy day—so after a brief discussion with Tom Hodge WA2YTM at the Ramsey booth, my wallet was lighter and my carry-all bag somewhat heavier. Tom figured it would take me about three evenings to put the kit together and get it on the air. (Note to novice builders: The term "evening" is a standard measurement among kit builders that has about as much relevance today as "furlongs per fortnight." A more realistic appraisal of the time required to build this kit might be six to eight hours, depending on how methodically you work.)

When you first open up the kit package, you'll notice all of the parts and the circuit board neatly sorted into clear ziplock bags. All parts are clearly identified, and all ICs are wrapped in foil for static protection.

If you bought the chassis and knob kit, it too is packaged carefully to minimize scratching. But the best part of the kit is the instruction manual, which answers every possible question you could have as you proceed with assembly.

This manual is over 130 pages long and contains detailed parts lists, assembly instructions, schematics, a parts overlay, and a good deal of what I call "pep talk"—additional material not usually found in kit instructions which is designed to motivate you to want to build the kit and have fun while doing so. In some cases this is nothing more than illustrating how simple the step-by-step procedure is.

The manual also provides a good many helpful notes and tables on how synthesizers work, how to select the right antenna, and how to select and program your desired channels. I've built quite a few kits over the past 25 years, so believe me when I tell you the manual can make or break a kit! The standard for me has always been the Heathkit manuals, and the FX-146 manual compares favorably with any I've seen from Benton Harbor.

Construction

Kit assembly is fairly simple. I suggest locating a number of half-pint plastic deli containers to hold all parts as you proceed. Another useful trick is to double up a piece of masking tape, stick it to your work surface and use it to hold loose components until needed. Many of the parts supplied are already attached to taped rolls, such as the 1N914 diodes and many small capacitors and resistors. A low-wattage iron (say, 40 watts) as well as a pair of diagonal cutters and small pliers will suffice as your tool kit for most of the assembly.

Like the aforementioned Heathkit manuals, Ramsey employs the double-check system during assembly. You locate the part, install it, solder and then "check off" the corresponding box next to that instruction. After you finish a section of the board, you go back, inspect your work and check off again to confirm you did the step correctly. A simple idea, but it really works! Even experienced kit builders such as myself find this system very helpful.

Before you begin each section, there is a thorough description of the circuit and how it works—sort of a mini-tutorial on the fly. After reading these sections, you then proceed to actual assembly. Ramsey's approach is to divide the construction into 11 stages. As you finish each stage, you can perform a short test to make sure everything was done correctly. This will do wonders for your confidence as you proceed to the next section, and should a problem develop it can be isolated and fixed quickly.

Once all of the stages have been tested (with the exception of the RF amplifier), you'll need to load up at least one diode matrix into a channel. I found the easiest way to do this was to raise up the edges of the PC board on two wooden blocks about three inches above my workbench. This allows you to drop all of the diodes through their PC mounting holes and solder the cathode ends to the U-shaped buss bar. Once you've done this, flip the board over and solder the anode ends to the PC board traces.

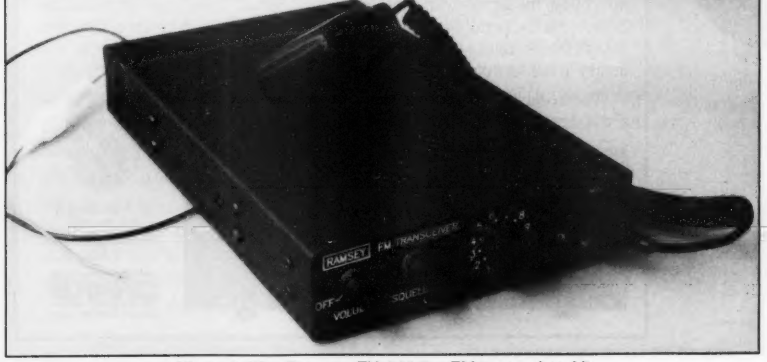

Photo A. The Ramsey FX-146 2m FM transceiver kit.

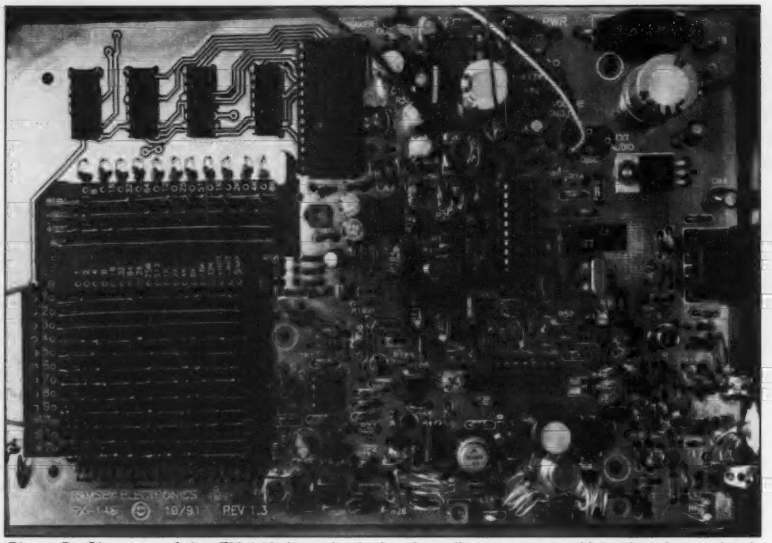

Photo B. Close-up of the FX-146 (top view) showing all components. Note the clean, simple design.

Clip excess leads off carefully.

One word of advice when doing this: Make sure you solder the cathode-to-buss connections carefully. It might even be advisable to bend the diode leads into a hook and hang them over the buss wire before soldering. I had a few cold connections and certain channels wouldn't work when selected.

Performance

The FX-146 works surprisingly well, given the simple design. Front-end sensitivity is claimed to be less than 0.35 µV for 12 dB SINAD, and my tests showed this figure to be closer to 0.30 µV. Adjacent channel rejection is specified to be down 6 dB +/-7 kHz, and -60 dB +/-15 kHz, which is pretty tight. An option included with the kit will improve front-end performance even more for those in high-RF-density urban areas, although I haven't found it necessary yet.

The squelch threshold is specified at 0.25 µV, and again I found this to be somewhat lower. Squelch hysteresis performance is good, but I found the loud "pop" objectionable each time the squelch was broken or reset. This is caused by the "gating" of the audio output IC, a LM380 linear device. A call to the factory resulted in a modification to change C48 from a 0.001 disc to a 10 µF electrolytic, ostensibly to filter out this pop when the IC turned on. The fix made a slight improvement, but the pop is still somewhat annoying.

The FX-146 is set up to select any of 12 preprogrammed channels, the theory being that most users of synthesized radios rarely use more than 10 to 12 memory channels to begin with. This is certainly true in my case, as I use a Kenwood TM221A with 10 memories for day-to-day 2 meter operation. Actual channel selection uses a conventional 12-position single-pole switch to send 5 volts to the desired channel buss. It's not sexy, but sure is simple and reliable! Synthesizer lock-up

"The R8 is a like a breath of fresh air, with its ground-up engineering and up-to-date digital control from the front panel... a quality HF receiver of American manufacture that should successfully compete on the world market."
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73 Amateur Radio Today

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Monitoring Times

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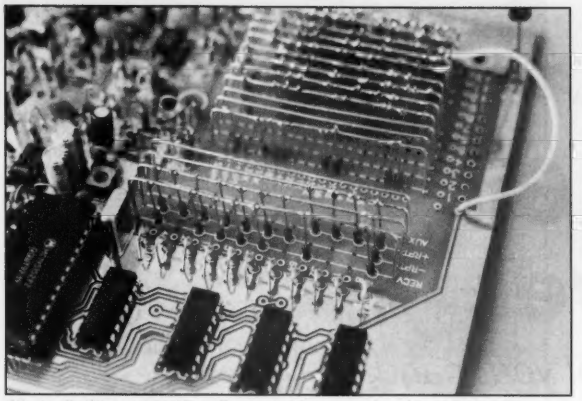

Photo C. Close-up of the diode matrix area, showing the buss connection technique.

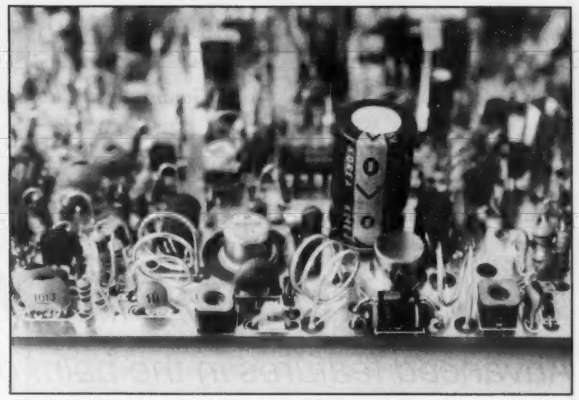

Photo D. Close-up of the final amplifier assembly, showing the trimmers and output coils.

was quick and reliable on every channel (except where I made a couple of cold solder joints).

On-air reports were good. Initially, I was told my audio had a fairly noticeable hum which disappeared when I replaced the ICOM HM-9 speaker/mike with an HM-54. Transmitted audio quality was excellent, and there's plenty of headroom on the microphone gain control although there is no separate deviation control. The FX-146 uses true direct frequency modulation, by the way.

Output power is specified in the 4 to 6 watt range, but try as I might, I couldn't squeeze more than 3.5 watts out of the FX146 anywhere in the band. (I used a Bird 43 with 10C and 5C slugs plus a Bendix 50 ohm termination to make these measurements.) Note that the driver and final RF stages use lumped, Hi-Q tuning coils and trimmers (Photo D), and once you've peaked up the trimmers you'll see a fall-off in power if you move up or down the band more than half a megahertz. Still, this power level is more than adequate for most contacts through a repeater, and with a omnidirectional antenna or small beam, you'll get out a good distance.

Overall, the FX-146 represents an excellent value for the money. Its performance is on a par with any other 2 meter transceivers on the market today (other than the squelch pop), and it is easy to assemble and test . . . thereby making it easy to troubleshoot later if repairs are needed. If you really want to "build it yourself," you'd be hard pressed to beat this kit for fun and utility.

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THE POWER STATION

The POWER STATION is a 12V x 6.5 AmpHr gel-cell battery complete with voltmeter, wall charger and a cord for charging via automobiles. It will power most HT's at 5 Watts for 2-4 weeks (depending upon how long-winded you are). Also VHF, UHF, QRP, or HF mobiles such as the KENWOOD TS-50 (at 50W). There are no hidden costs, all you need is your mobile, HT power cord or cigarette lighter adapter.

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CIRCLE 384 ON READER SERVICE CARD

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147 New Hyde Park Rd.
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Price Class: $379 plus $5 shipping

The 6 meter band is brimful of excitement for every ham, from the new no-code Technician to the seasoned Extra Class. But don't get the wrong idea—even though 6 meters is exciting, there's still plenty of elbow room in the sparsely-occupied spectrum from 50 to 54 MHz.

FM is the predominant mode on 6 meters. There should be no FM operation below 50.30 because this area is reserved for the SSB and CW weak-signal operation found in large multimode mobile and gas station equipment. Remember: *No FM below 50.30 MHz!*

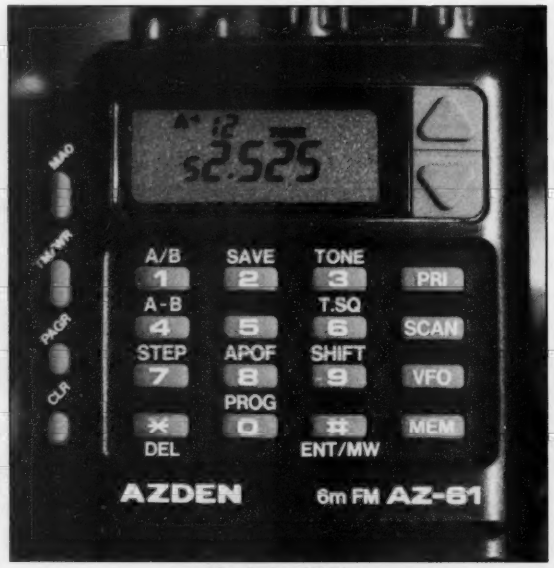
A good way to get started in 6 meter FM communications might be to pick up a good hand-held transceiver. And while you may think that a measly 3 or 4 watts output won't do much on the 6 meter band, keep in mind that this is the same amount of power output found in 2 meter handhelds.

One unique characteristic of the 6 meter band is it allows small hand-held transceivers to work distant repeaters just as far as on 2 meters, and will sometimes give you *real* FM excitement during periods of ionospheric sporadic E band openings. You may find yourself working through a repeater 1,200 miles away, thanks to brief skywave band openings. And keep in mind that sporadic E band openings are not dependent on the 11-year solar cycle. You can count on 6 meter skywave activity during the summer and fall seasons. And while it may only last for a few minutes to a few hours, hand-held operation gets exciting—especially if you are hooked into an outdoor antenna.

The Azden AZ-61 6 meter hand-held transceiver is available direct from the manufacturer: Azden Corporation, 147 New Hyde Park Road, Franklin Square NY 11010 (516/328-7500), Attn: Sid Wolin K2LJH, Manager. The Azden line of amateur radio equipment has been around as long as the synthesized 2 meter transceiver, and is now available direct from New York.

"A good way to get started in 6 meter FM communications might be to pick up a good hand-held transceiver."

This Azden looked perfect for the Southern California 6 meter Club. They were searching for a quality hand-held 6 meter transceiver that they could order in quantity. The unit sounds fine on the air, and most members are relatively satisfied with their purchase.



The Azden AZ-61.

Features

The review transceiver was shipped with the Azden 2 meter owner's manual. We are told that a 6 meter manual is in the works, but the variations between how a 2 meter Azden works and how the little 6 meter handheld works are minor. Well, almost . . .

Unlike the 2 meter version, the Azden 6 meter handheld offers no oddball duplex split—it is set for +/- 500 kHz, with frequency steps at 5 kHz, 10 kHz, or 20 kHz. You will also quickly discover that receiving channels in the VFO and memory mode are slightly different for the 6 meter unit than what is described in the 2 meter owner's manual.

The Azden 6 meter handheld is packed with all the usual accessories, including the 8"-long flexible rubber antenna, sturdy belt clip, and the large 12 volt, 600 miliamp hour, rechargeable battery. The battery is shipped uncharged from the manufacturer, so you will need to drop it in its included pull-out desk charge stand and let it cook for at least six hours before turning on the juice. The charger puts out 300 miliamps, and the transformer is housed in the plug-in assembly, hogging an adjacent 110 VAC receptacle beside it if you plug it into a power strip. And be assured that this charging base setup is unique to Azden's line of handhelds, and there is zero chance that it is interchangeable with any other handheld from any other manufacturer. Why won't manufacturers ever standardize their batteries or chargers?

On the top of the handheld is a 12-volt DC input receptacle, with the center-pin positive. *Watch out—even though you may already have a mobile 12 volt hand-held plug that looks similar to this jack, make absolutely sure that your 12 volt plug has the center hole as positive.* Some other handhelds run positive on the outside of the plug, not the inside hole.

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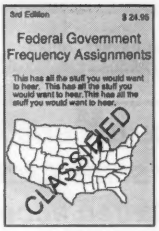

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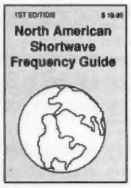

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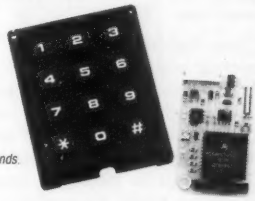

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CIRCLE 10 ON READER SERVICE CARD

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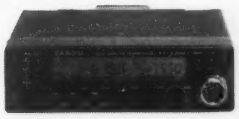

FT-411E, 2 Meter
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FT-911E, 1.2GHz
FT-415, 2 Meter
FT-815, 440MHz
FT-26, 2 Meter
FT-76, 440 MHz
FT-23R, 2 Meter
FT-33, 220 MHz
FT-470, 2M/440MHz

FT-416
New 2 Meter
FT-816, 440 MHz

FT-212RH, 2 Meter
FT-712RH, 440MHz
FT-7400H, 440 MHz
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CIRCLE 131 ON READER SERVICE CARD

Reverse polarity means instant destruction t o the 12 volt DC input circuitry to this handheld.

During our testing, we discovered that the 12 volt input circuit does not charge the attached battery. This was not a surprise—some handheld manufacturers provide a 12 volt regulator for mobile charging, but others don't. We *did* find that there is a small "buffer" circuit off the external 12 volt line to help minimize alternator noise that sometimes creeps through on transmit. On this unit, we judged this circuit as average. If you have an aggressive 12 volt alternator, you're going to hear it over-transmit on the Azden—as you would on any inexpensive handheld.

Operating: Read the Book First

The Azden 6 meter handheld is not easily operated without a thorough review of the instruction book. Most seasoned hams can figure out the simple operation and memory channel steps of most handhelds without a book—except for maybe the Kenwood 78—but with this Azden, you must read first.

To enter a frequency like 52.525 MHz, first hit the "VFO" key, then enter "2," "*" (Del), "5," "2," "5," and the unit continues to blink for about a second until it locks on. If you don't hit the "*" (Del) key to set the decimal point, the unit won't take the frequency, and will continue to flash at you for about 10 seconds after your last futile keystroke. After 10 seconds, it figures that you need some help, and goes back to the last valid frequency entered. Remember: *Read the book before operating.*

Once the set accepts the valid frequency entry, it reads out "52.525" and does a nice job of capturing any signal out there on frequency. The receiver was plenty sensitive down to 0.08 µV, and with dual conversion was tight enough to offer excellent selectivity from other stations slightly higher and slightly lower in frequency. The Azden 6 meter handheld utilizes a hard-squelch circuit, and marginal signals will cause the squelch to clamp with a noticeable "pop" as an internal transistor clamps the audio off. But if you accidentally forget and turn down the volume, this hard squelch "pop" might get your attention in a quiet room—there may be someone on channel trying to get through. Few handhelds offer "soft squelch," and in strong signal areas where most operating is through repeaters, the hard squelch in this unit is perfectly acceptable.

Audio output and fidelity from the internal speaker are excellent. If you plug in the optional external speaker/mike, you'll have more than enough audio to hear any call to you (if the speaker/mike is anywhere near your ear). Good news: Many of the generic speaker/microphones have the same exact plug complement that the Azden accepts. Some of the external crossband speaker/microphones run a little hot on transmit modulation, so double-check your levels after you get your external setup plugged in.

The Azden 6 meter handheld offers 40 channels of memory, 20 in memory bank A and 20 in memory bank B. You select the memory bank channel by pressing "function" A/B, and then pressing the number of the memory channel desired. To enter a frequency into a memory channel, you must first recall the memory channel you want to program. Then press VFO, and set the frequency.

For the offset, you hold the function button on the side of the unit while depressing the number 9 key. This allows you to select no offset simplex, minus 500 kHz offset down, or plus 500 kHz offset up. No oddball offsets are available on this unit.

To encode a subaudible tone, you hold the function button again and push the zero key. This activates the "PROG" program display, and you cycle with the pound key (#) past "T.SQ" tone squelch decode, and TO "Tone" for tone encode. Cycle up to the desired tone by exact tone frequency, and then wait approximately five seconds for the unit to time out of the program mode, and get you back into the VFO display mode. Now depress the function button again and the "3" key, and this brings up the word "Tone," indicating CTCSS encode each time you transmit.

Now, memorize this package into any one of 20 + 20 memory channels by holding the "ENT/MW" pound key until you hear a beep.

There are several other options that you could program on each memory channel, too:

CTCSS decode
CTCSS encode
Frequency step
Scan hold time
A-bank scan skip
B-bank scan skip
Automatic power off time
Battery saving time
DTMF pager/calling

And there are even a few more things that you can do with this handheld, which we would classify as "advanced operating features."

"The set is too darn complicated," comments an active 6 meter enthusiast. I didn't find this necessarily true—I must admit it's certainly not a handheld that you can take out of the box, and start punching in frequencies, offset, and tone without looking at the instruction manual (like some handhelds I know of). But if you do read the instruction manual, the operating and programming is easy.

"Good news: Many of the generic speaker/microphones have the same exact plug complement that the Azden accepts."

This IS an advanced-feature handheld, so it takes about an hour of programming in order to get the "feel" for how frequencies, offset and tone get memorized.

About the only thing I found a problem with was slow synthesizer lock time which all but eliminates the capability of cycling through frequencies with the up or down arrow looking for activity. As soon as you press the up and down arrow frequency slew button, the receiver blanks out until you release the button. You could electronically scan the 6 meter band for activity, but I like to go into the manual mode, and search down at the cordless telephone frequencies near 46 MHz and 49 MHz and see what all I can pick up. (Cordless is legal.) Lots of excitement here!

So, I like it. I like the Azden AZ-61 6 meter handheld a lot. Just be sure to read the instruction manual first!

ARRL 6 Meter Wavelength Band Plan, 50.0-54.0 MHz

MHz	Use
50.100-50.300	SSB,CW
50.100-50.125	DX window
50.110	SSB calling frequency
50.300-50.600	Non-voice communications
50.620	Digital/packet calling frequency
50.800-50.980	Radio control, 20 kHz channels
51.000-51.100	Pacific DX window
51.120-51.480	Repeater inputs (19)
51.120-51.180	Digital repeater inputs
51.620-51.980	Repeater outputs (19)
51.620-51.680	Digital repeater outputs
52.000-52.480	Repeater inputs (23)
52.020, 52.040	FM simplex
52.500-52.980	Repeater outputs (23)
52.525, 52.540	FM simplex
53.000-54.480	Repeater inputs (19)
53.000, 53.020	FM simplex
53.1/53.2/53.3/53.4**	Radio control**
53.500-53.980	Repeater outputs (19)
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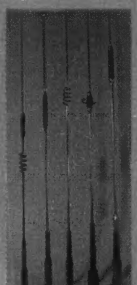

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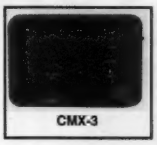
This new cross needle S.W.R. meter gives forward and reverse readings without switching and provides for three diferent power levels. You can even monitor your 12 volt power source. The remote R.F. sensor allows you to place the meter near you and the sensor at the radio.


CMX-3

CMX-1	1.8 to 60 MHz @2 kW	$189.95
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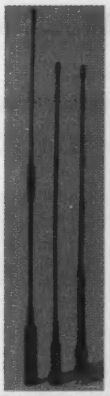

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Comet mounts

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RS-820

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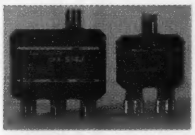
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Holiday value

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Photo Shows IC-Delta 1A

This new dual-band handheld transceiver offers unsurpassed performance and the kind of innovative features amateurs have come to expect from Icom. From the unique new whisper function and auto-output power selection to many other trend- setting features, the W21AT is so impressive you'll want to experience for yourself. This radio sports 70 memories, pager, CTCSS and many other features.

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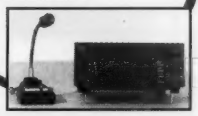
This advanced transceiver features DDS, dual antenna ports, dual VFO display, 101 memories, internal antenna tuner, built-in keyer and 105 dB dynamic receive range. Join the DX scene with the latest design.

IC-735

Holiday value
$999.95

The classic HF all-band transceiver that you've been asking for...the most compact and advanced full-featured radio with general coverage on the market.



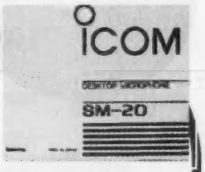
NEW

IC-707

Here's 9 pounds of fun with a display that's easy to see, a front panel that's easy to work with and performance to spare. You get big rig specs in an HF transceiver designed for mobile and portable use. Features include a noise blanker, pre-amp, 100 watts out, 32 memories and great sensitivity.

Holiday Value
$819.95

We are an authorized Icom service center



Icom microphone

This new high style desk mic features PTT, lock, up-down control, mic gain and low cut switch.

Holiday value
$135.95

IC-728

Holiday value
$889.95

The IC-728 is a fully equipped compact transceiver. It comes with the basic features plus additional functions required for pleasurable HF operation such as passband tuning and a speech compressor. Perfect for mobile operation with a bright display and simple controls.

Also available
IC-729 with 6 meters

IC-275H

Holiday value
$1339.95

The beauty of the all-mode IC-275H from Icom is that is gives you the best of both worlds- accesibility to the far-flung reaches of the earth combined with tremendous simplicity. At just the touch of a few switches you can contact places in the world you've always dreamed of visiting.

IC-475H-- 70cm all mode
IC-575H-- 6m all mode

IC-765

Holiday value
$2339.95

Performance with easy-to-use features. With a full-featured front panel and a large fluorescent display, this radio was designed to be used!. Wide dynamic range, full duty cycle heat sink, 99 memories, DDS and high speed antenna tuner will expand your fun.

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KENWOOD

TS-50S

Holiday value $1049.95

Enjoy high performance communications plus go-anywhere convenience with the world's smallest 100w mobile HF transceiver. It opens up a whole new world for the amateur radio operator. It can be mounted in a vehicle, taken on a DX-pedition, or even permanently installed as a base station transceiver.

Holiday value $53.95

Holiday value $89.95

TS-850S/AT

A rewarding experience. Kenwood's renowned digital technology endows the TS-850S/AT HF transceiver with specs that put it firmly in the top ranks of amateur radio equipment. Features include a preprogrammed automatic antenna tuner (built-in or optional), Kenwood's Advanced Intercept Point system for enhanced dynamic range, 100 memories with three scan modes, a Direct Digital Synthesizer (DDS) and digital PLL system, plus an optional digital signal processor.

Holiday Value $1769.95

TS-450S/AT

A radio that can star in virtually any role with its 100w transmission capabilities on all nine amateur bands. Compact, lightweight construction makes this HF transceiver particularly suited for DX-ing. Rugged reliability is matched with leading-edge electronics- automatic antenna tuner, Kenwood's AIP system for improved dynamic range, DDS for fine tuning and the optional DSR-100 digital signal processor.

Holiday value $1329.95

TS-950SDX

Swift performance and surgical precision are second nature to the TS-950SDX. Quality engineering blends aesthetic simplicity of form with a wide range of advanced features- dual frequency receive, 100 memories, DSP, MOS FET final section (a first for amateur transceivers) and much much more.

Holiday value $3969.95

TS-140S

Holiday value $879.95

The perfect entry-level HF transceiver. All-mode performance is enhanced by numerous user-oriented features such as 31 memories, a dual-mode noise blanker with level control, CW full & semi break-in, built-in speech processor and it's light enough for DX-peditions and mobile use.

TR-751A

Holiday value $629.95

To meet the ever-growing demand for all-mode operations on the move, Kenwood has developed a compact, lightweight transceiver that performs with proficiency. While providing the full-featured convenience of much larger rigs-- including dual digital VFOs, all-mode squelch and semi break-in-- this model is designed to function as well in your vehicle as it does in your shack.

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The Radio City Advantage

Radio City offers factory authorized warranty service for Icom, Kenwood, Yaesu and Sony.

KENWOOD

Kenwood microphones

TH-78A

Holiday value
$426.93

Price Blowout

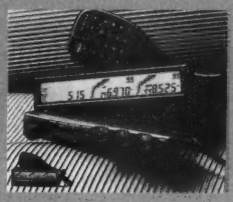
Compact and confident, it sets exciting new standards for portable communications, combining simplicity of operation with a multiplicity of features. In addition to built-in DTSS and paging functions, it provides a dual-frequency transceive capability, wide band receive, a sliding keypad cover, and many other features. While supplies last.

TS-790A

State of the art, and then some. Demonstrating the full potential of an all-mode transceiver equipped with advanced electronics, Kenwood's high-quality TS-790A breaks new ground in terms of both features and performance. And when equipped with the optional 1200 MHz unit, it offers tri-band coverage for maximum versatility. Supporting its dual-frequency receive capability are separate readouts and controls for main and sub bands, and even full-duplex cross-band operation is possible.

Holiday value
$1779.95

TM-742A

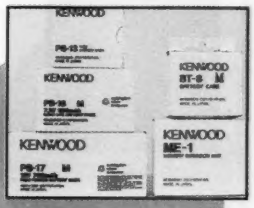


New VHF/UHF tri-bander with third band optional. This new transceiver has all the features and advantages of the TM-741 plus these enhancements- direct frequency entry, the unit can separate into three pieces (requires remote cable kit), CTCSS encode is built in, and it can be controlled remotely with DTMF signals from any transceiver. Also available in a tri-band model (the TM-842A)

Holiday Value
$759.95

Holiday value
$79.95

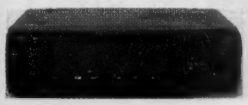
Kenwood SP-23



Kenwood Accessories

They make great stocking stuffers!

TM-732A



Holiday value
$609.95

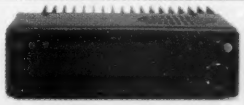
Attuned to the fast-moving world of mobile communications, this dual-band transceiver offers a host of advanced features in a compact design. The detachable front panel has a high-visibility LCD display to keep you informed of operational status.

TH-28A

Holiday value
$309.95

This state of the art HT has numerous features- the ability to store both alphanumeric and frequency data in non-volatile memory, AM aircraft, alphanumeric message paging-- in addition to DTSS and pager functions-- plus switchable dual-band receive. As an added bonus the number of memory channels can be increased to 240 (option).

TM-241A



Holiday value
$374.95

This 2 meter FM mobile provides the user-friendly operation the amateur radio operator expects from Kenwood. It comes complete with extra-large display, DTMF microphone, wide band receive and illuminated switches. For the experienced operator, an additional feature is available which allows you to connect to as many as 4 mobile transceivers by remote control.

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YAESU

FT-1000

Fun's fun, but you can be very serious with this heavy duty competitor. Dual receivers, 200 watt output, 99 memories and 108 dB dynamic range gives you the performance edge. This radio will help you collect more points in a contest and add more cards to your DX collection. The specs tell the story, but it's the ride that's exciting.

Holiday value

$3899.95

FT-990

Based on the acclaimed performance and easy operation of the FT-1000, the new FT-990 combines the basic technical features of that top-of-the-line model with several new advances in both transmitter and receiver circuitry, resulting in a spectacular performer at a reasonable price. Digital filter, 90 memories, wide dynamic range and much more!

Holiday value

$2059.95

NEW

FT-840

This new transceiver delivers the fun and erformance you're looking for while staying on a budget! It has100 watt output, 100 memories, DDS, IF Shift, FET front end and a general coverage receiver, all for a low price.

FC-10 Matching antenna tuner, external
FC-800 Remote antenna tuner

Holiday Value

$799.95

FT-290

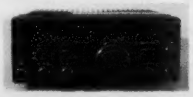
Portable or mobile, this 2 meter all-mode transceiver delivers fun and function. The 25 watt linear amplifier clips on in place of an optional battery case to extend your operating horizon.

Holiday value

$559.95

FT-690 6m transceiver $669.95
FT-790 70 cm transceiver $669.95

FT-890AT



A fine blend of high performance features borrowed from the FT-1000 and the FT-990 are combined in this affordable transceiver. Pass band tuning, variable notch filter, variable noise blanker and VOX dress out this 100W rig. This model includes a built-in antenna tuner to expand your mobile fun. Great for base operation also.

Holiday value

$1319.95

FT-747GX

Holiday value

$729.95

Perfect portable proportions in a full-featured 100 W transceiver. This radio gives rugged lightweight performance in your car, boat or cabin. Just right for home, too!

Holiday value

$1719.95

FT-736R

Satellite and all-mode 2m/70cm work gets exciting with this full-feature transceiver. Linked tuning, 12 uplink memories, 100 general purpose memories, and room for 2 optional modules offering band extensions for 6m, 220MHz, or 1.2 GHz operation.

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YAESU

FT-5200

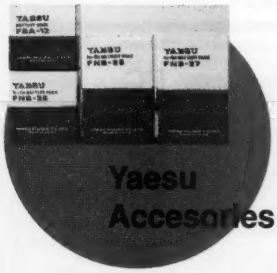
The removable front panel lets this dual bander fit any installation. It features 50w out on 2 meters, 35w out on 70 centimeters, 32 memories, CTCSS encode and PAGE mode.

Holiday value
$629.95

FT-530

The newest member of the dual band family. This handheld sports auto tone search, 82 memory channels, automatic power off, built-in VOX, dual in-band receive feature, built-in cross band repeat function and much more.

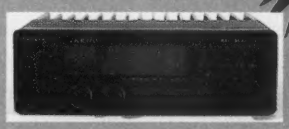
Holiday value
$449.95



Yaesu Accesories

FT-2400

Holiday Value



This rugged military-grade 2 meter mobile provides wide band receive, 3 power output levels, a lighted keypad and 26 memories. Join the fun!

$336.28

FT-7400
Has the same great features as the FT-2400 but is designed for the 440 band.

$459.95

Free hat!

From now through 12/25/93, receive a free Yaesu hat with the purchase of any radio featured on this page.

FT-5100

Holiday value
$599.95

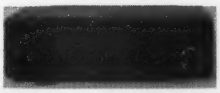
This dual band mobile features 100 memories, cross band repeat, lighted keypad, built-in duplexer and a small footprint. Dual watch capability rounds out this 50/35 watt VHF/UHF transceiver. Packet ready.

Holiday value
$295.95

NEW

FT-2200

Holiday value
$369.95



This compact, full-featured mobile comes with 49 memories, 10 DTMF autodial memories, A.R.S., CTCSS encode and digital squelch as standard features. Power output ranges of 5, 25 and 50 watts let you select just the right amount of power. The lighted keypad and microphone make night use a breeze.

FT-416

Holiday value
$345.95

This new VHF handheld transceiver provides the latest features- auto tone search, automatic battery saver, automatic power off, 41 memories, CTCSS encode/decode, DTMF paging, backlit keypad and display and a choice of two colors (black or grey).
FT-816 UHF version available.

Holiday value
$409.95

FT-470

High tech performance is the name of the game with this full-featured dual-band handheld. The durable construction lets you take it anywhere and enjoy reliable operation. The unit is equipped with CTCSS, 42 memories, 4 VFOs and 10 auto dialer memories.

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Iso-Loop

Model 10-30HF

Holiday value
$319.95

Perfect for amateurs living in areas with antenna restrictions. This omnidirectional antenna features high Q, high efficiency and high fun!

AEA

AEA FAX

Holiday value
$99.95

AEA Fax is a multi-intensity gray scale facsimile receiving system for the IBM and compatible systems that allows you to copy gray scale fax images from the HF bands with your short-wave receiver. An on-screen tuning scope aids in optimum reception. You need an IBM PC, XT, AT or compatible with at least 640K, DOS 2.1 or higher and 1 serial port. The system also supports HP LaserJet or Epson compatible printers.

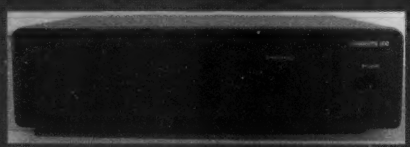
Ham Link

Holiday value
$239.95

Your radio is as close as your telephone with Ham Link. The keypad on your touch tone phone becomes your remote control to your radio. Change bands and frequencies, tune up or down, switch modes (AM/SSB/FM/CW), scan, run split VFO or virtually any other radio feature you have. If CW is your thing, you can use the ARE-80 CW Link with your Ham Link. This option allows the use of a high-speed keyer at the user end.

Now with PACTOR!

PK-900



Holiday Value
$475.95

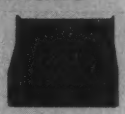
PC Pakratt for Windows

This is the first and only data controller program for Microsoft Windows® on the market today! It works with the entire family of data controllers, including the new PK-900 and DSP-2232. It can run two AEA TNCs simultaneously and provides easy access to useful tools such as write, notepad, and control panel. Other features include support for VHF and HF packet, ASCII, AMTOR, PACTOR, Baudot, Morse code, Signal Analysis and Dumb Terminal modes, and a built-int QSO logging program. It requires Windows 3.1, 4M of free hard disk storage space and 2M RAM (4M recommended).

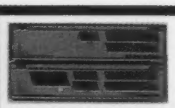
Holiday value
$124.95

IT-1 Automatic Tuner

Holiday value
$249.95



This automatic antenna tuner is designed for the Iso-Loop and makes tuning a snap. Features include a 12 button keyped, 10 segment LED bar, 8 memories and serial interface.



DSP-1232
DSP-2232

Take a fast trip to the future with these digital signal processing (DSP) multi-mode data controllers! AEA has the most advanced and adaptable data controllers on the market today: the DSP-1232 with two switchable ports and the DSP-2232 with two simultaneous ports. The capabilities for both are endless. *Now supplied with PACTOR.*

DSP-1232
$699.95

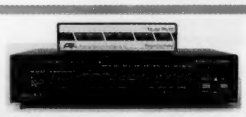
DSP-2232
$889.95

SWR-121

NEW

Holiday value
$349.95

This handheld programmable HF antenna analyst presents a graphic image of your antenna performance. Download this data for future reference.



PK-88

This HF/VHF packet TNC is your best value in packet radio! The PK-88 is loaded with unique operating features and backed with proven hardware and software design.

$135.95

PK-232MBX

This controller combines all the amateur data communication modes into one comprehensive unit. Over 65,000 have been sold worldwide. *Now with PACTOR!*

$319.95

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New Satellites

The flight of Ariane V-59 was originally scheduled for September 1st. The primary payload, SPOT-3, encountered technical difficulties requiring a launch slip to late September. If all goes as planned, six smaller satellites will be mounted on a ring at the base of SPOT-3. They include Stella, Healthsat, PoSaT-1, Itamsat-A, Kitsat-B and Eyesat-A. Two of the satellites are purely commercial, two contain both commercial and amateur payloads, and two are dedicated to amateur radio service.

The ejection sequence has SPOT-3 separating first, followed by Stella, Kitsat-B, PoSat-1, Healthsat, Eyesat-A and Itamsat-A. The OSCAR (Orbiting Satellite Carrying Amateur Radio) numbers associated with the new satellites are currently under discussion since Arsene has not yet been given the name Arsene-OSCAR-24. If Arsene is given a number, the suggested OSCAR numbers for the new hamsats are: Kitsat-OSCAR-25, PoSat-OSCAR-26, AMRAD-OSCAR-27 and Itamsat-OSCAR-28. The expected orbit of the new satellites is 800 km high with an inclination of 98.7 degrees. This is identical to that of the microsats, OSCARs 14-19.

Stella and Healthsat are the commercial secondary payloads. Stella is a German geodetic satellite and Healthsat is a test platform for small ground-station activity in support of efforts by VITA (Volunteers in Technical Assistance) and Satellife. It is a digital system that operates at 9.6 and 38.4 kbps (kilobytes per second).

The combination amateur/commercial satellites include PoSat-1 and Eyesat-A. PoSat comes from the Portuguese organization LNETI. The satellite's purpose is to provide experience to Portuguese nationals for the construction and operation of satellites.

PoSat-1 was built at the University of Surrey in England by members of the UoSAt team and a group of four engineers from Portugal. The satellite carries an earth-imaging camera capable of 200 meter resolution, a CCD (charge-coupled device) camera as a star sensor, a cosmic-ray detection experiment, a Trimble GPS (Global Positioning System) receiver and a DSP (Digital Signal Processing) experiment with two Texas Instruments processors. PoSat-1 will support 9.6 and 38.4 kbps operation on the amateur band frequencies. The primary amateur activity will likely involve the imaging experiment. Note Table 1 for details.

Eyesat-A is the first commercial satellite built on a microsat bus structure. It was manufactured by Interferometrics, Inc. of Vienna, Virginia. The amateur radio portion of this satellite was produced in cooperation with AMRAD, an experimentally-oriented organization in the Virginia suburbs of Washington, D.C. The satellite is capable of digital communication speeds from 300 to 19.2 kbps on the amateur bands. Although Table 1 shows operation only up to 9.6 kbps, onboard experiments can be initiated for operation above this. A crossband voice repeater with 70cm uplink and 2 meter downlink is also a possibility.

Kitsat-B and Itamsat-A are the two satellites dedicated to amateur-radio service to be carried aloft on the Ariane V-59 mission. Both satellites promise to be extremely popular additions to the current fleet of digital hamsats.

Kitsat-B is the second satellite from KAIST (Korean Advanced Institute of Science and Technology). While the first one, now known as Kitsat-OSCAR-23, was built at the University of Surrey and is based on the Surrey satellite frame, Kitsat-B is a completely Korean effort. This represents an important phase in the technology transfer between Surrey and KAIST. The new Kitsat carries many of the same type payloads as K-O-23, but has advancements in imaging capability and data transfer speed. More information on the scientific components of Kitsat-B can be found in the June "Hamsats" column. Operating frequencies are shown in Table 1.

Itamsat-A was built by AMSAT Italy and incorporates modifications and advances to the original microsat design. These upgrades have been used to modify designs for additional hamsats under construction in other parts of the world. While data communications rely primarily on the PSK (phase-shift keyed) modulation techniques of the current microsats, a 9.6 kbps system using FM up and down has been incorporated for compatibility with the highly successful UoSat and Kitsat designs now in orbit.

Photo A. Dick Jansson WD4FAB attended the AMSAT-UK meeting to present data on the new structure for the Phase-3-D satellite. (W5IU photo.)

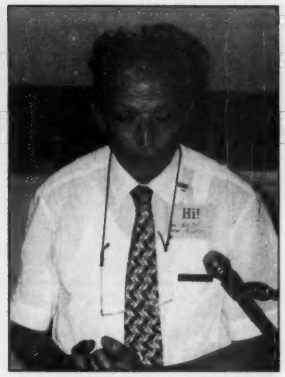

Photo B. Viktor Kudielka OE1VKW discovered the orbital mechanics responsible for the eventual decay of AMSAT-OSCAR-13's orbit. (W5IU photo.)

Future Satellites

In addition to those hamsats scheduled for the V-59 launch, UNAMSAT from Mexico and RS-15 from Russia are ready and waiting for their flight to space. CEsar-1 from Chile, SUNSAT from South Africa, HUTSAT from Finland, Sedsat from the U.S., Guerwin-1/Techsat from Israel and the International Phase-3-D project are under construction.

Details of these efforts and discussions concerning operations via the current group of operational hamsats were a significant part of the 1993 AMSAT-UK Colloquium. The meeting was held at the University of Surrey in late July and early August. Many well-known satellite designers and builders attended and presented papers detailing current and future efforts. Nearly 140 delegates from six continents exchanged views and stayed in touch with current findings and advancements relating to the new and future satellites.

Dick Jansson WD4FAB from AMSAT-NA detailed progress with the structural design of Phase-3-D. Viktor Kudielka OE1VKW described the causes for the eventual decay of

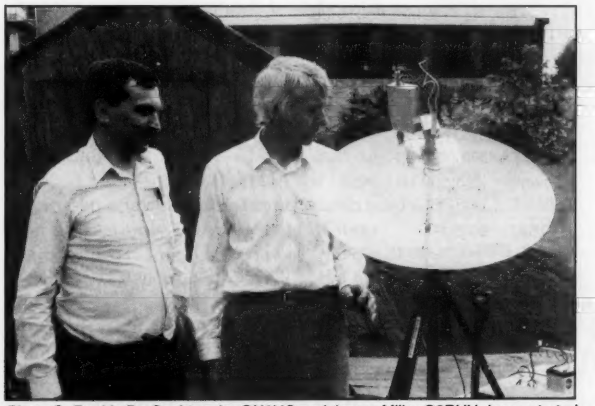

Photo C. Freddy De Guchteneire ON6UG and James Miller G3RUH demonstrated a small dish for 2.4 GHz amateur satellite reception at the AMSAT-UK meeting. (W5IU photo.)

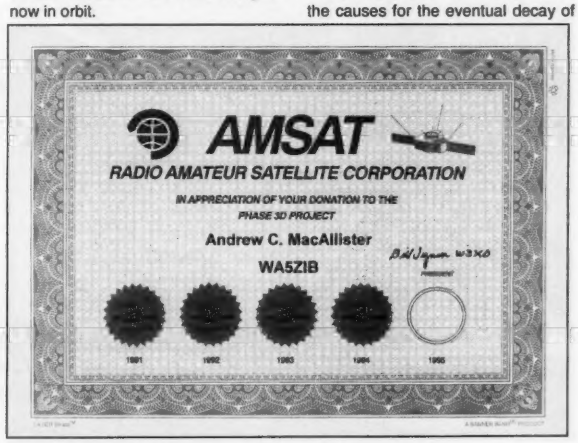

Figure 1. AMSAT certificate awarded for financial support of the Phase-3-D amateur radio satellite project.

Photo D. A close-up of the G3RUH Mode "S" receive system. (W5IU photo.)

Figure 2. ARRL QSL sent in recognition of donations for Phase-3-D, sent via the American Radio Relay League.

AMSAT-OSCAR-13's orbit and the need for caution planning the path of Phase-3-D. Other noteworthy talks included one on radio astronomy, descriptions of the transmitters and receivers to be carried on Phase-3-D and Mode "S" (2.4 GHz receive) efforts by James Miller G3RUH.

Table 2 shows the new designations relating to satellite frequency bands to be used on Phase-3-D. The satellite will use a matrix of separate transmitters and receivers and thus does not call out transponders that use specific uplink and downlink combinations. Thus Mode "B" (70cm up and 2 meters down) would be called Mode "UV" where the first letter describes the uplink and the second is the downlink. Innovative additions to Phase-3-D include a 5.654 GHz uplink, a 40 watt 10 GHz downlink, a new digital system called RUDAK-3 from Germany and a Japanese three-camera system with digital downlinks. All the transmitters for the new satellite are designed for much easier reception on earth.

James G3RUH gave a live demonstration of A-O-13 Mode "S" reception with his 60cm dish to show how easy microwave reception can be. A complete description of the construction of the small dish with helix feed was printed in the March/April issue of *The AMSAT Journal*. He also presented his 16-turn, 2.4 GHz helix used for direct A-O-13 "S" reception without a dish. Tests have proven that the small antenna is an adequate performer when used in conjunction with a low-noise preamplifier and a good converter system. James reminded those attending his talk that the effective radiated power at 2.4 GHz for A-O-13 is only 5 watts. Signals from Phase-3-D at 2.4 GHz should be somewhere between 5-20 kilowatts. This 30-36 dB signal increase means that the small helix is significant overkill. A quarter-wave whip (about an inch long!) should work just fine for Phase-3-D.

Support for Phase-3-D

All the incredible capabilities slated for Phase-3-D come at a price. This will be the largest, most comprehensive and expensive amateur radio satellite to date. The program needs money in addition to the donated parts and labor.

AMSAT-NA has been promoting the project and raising funds for several years. A special contribution program based on yearly donations over a five year period started in 1991. With a minimum contribution of $36.92, AMSAT will reply with a special Phase-3-D certificate with one sticker. Additional donations of at least $36.92 each, bring more endorsement stickers to fill out the years from 1991 through 1995, when AMSAT hopes to launch Phase-3-D. AMSAT can be contacted via phone at (301) 589-6062 or by mail at 850 Sligo Ave. #600, Silver Spring MD 20910.

The American Radio Relay League launched a program in June with a mailing to all ARRL members briefly describing the Phase-3-D project and proposing an ARRL goal to raise $300,000 from League members. Every contribution to Phase 3-D made through the ARRL is acknowledged with a unique QSL to serve as a permanent confirmation of support. The ARRL can be reached at 225 Main Street, Newington CT 06111. Be sure to mark any donations to the attention of Phase-3-D.

Photo E. Two AMSAT-UK meeting attendees inspect the G3RUH 16-turn helix for Mode "S" reception from AMSAT-OSCAR-13. (W5IU photo.)

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Uplink	145.850 MHz
Downlink	436.800 MHz
Speed	300-9600 baud (19.2 kbps downlink possible)
POSAT:	
Uplink	145.925/145.975 MHz
Downlink	435.250/435.275 MHz (435.250 MHz primary)
Speed	9600 bps (38.4 kbps likely)

Table 1. Frequency plans for the V-59 hamsats.

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435 MHz Band U	2.4 GHz Band S	10 GHz Band X

Table 2. New satellite mode designations for Phase-3-D.

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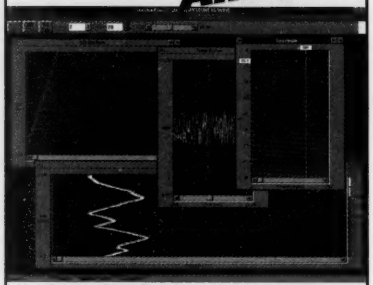

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Magnet Circuit Correction

I hate to do this, but I am going to ask all of you to take your seats, get out your notebooks, and turn back a few sections to the notes you took on this column a few months ago. You didn't take any notes? Shame on you, now you'll have to go get the magazine itself. Why do I ask such a thing? Because there is a mistake in a schematic, and I don't want anyone tripping over it!

In the August 1993 edition of "RTTY Loop," I printed a selector magnet circuit designed by Bob Roehrig K9EUI. Unfortunately, somewhere along the line, a part of the diagram entered the great bit bucket in the sky. The corrected portion is shown in Figure 1. Without the missing resistors (R7 and R8), the keyboard will short out the 120 volt supply. So, get out your notes or magazine, and pencil in the correction NOW! You never can tell when you might decide to use this versatile circuit, and I'd hate to see you ruin a perfectly good power supply.

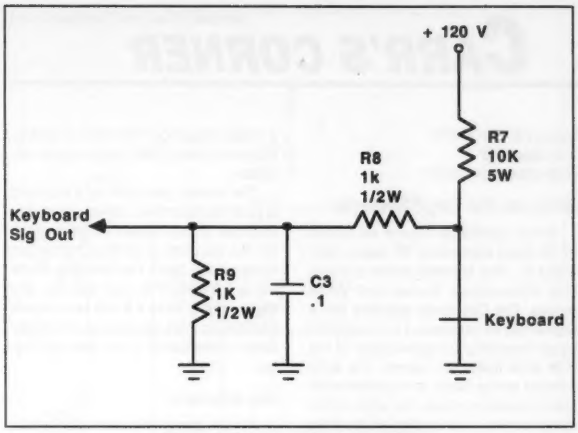

Figure 1. Selector magnet correction.

Digital Communications Terms

Moving right along, here's a letter from Bob Workman WA4ZZN of Atlantic Beach, North Carolina, which typifies the confusion which besets the ham entering digital communications. There are computer programs which simulate a TNC, and there are TNCs which require some kind of terminal, and there are terminal units which are needed by TNCs or programs to work. Bob needs clarification of this whole confusing mess of terms.

We need to begin somewhere, so let's start with some information encoded in digital pulses. These may be off a loop supply from a mechanical teleprinter or from a computer. These individual letters or characters need to be formed into the packets needed for packet radio communications. This is the function of the device commonly called a TNC, or Terminal Node Controller. Having formed those packets, the next step is to impress the packets of data onto a radio signal. This is done by some form of frequency shift keying, either audio frequency shift keying (AFSK) or radio frequency shift keying (FSK)—the former being used on VHF, the latter on HF. Reception is accomplished by receiving the frequency shifted signal, taking the audio output and converting it to on-off digital pulses through a demodulator or terminal unit, and then allowing our TNC to disassemble the packets and reproduce the desired communication.

Since conventional RTTY has no need for packet assembly or disassembly, a TNC is not used for this mode, only a terminal unit for reception. Some of the terminal units which have gained popularity in recent years are the HAL Communications ST-5, ST-6, ST-5000, and ST-6000; Flesher TU-170; and many, many others.

While many hams use TNCs which are small circuit boards external to the terminal or computer, there are programs available for many computers which can create a TNC in software. For these systems, all you need is a radio interface, which may be affected by a terminal unit originally designed for RTTY only.

Conversely, there are many controllers on the market which integrate the TNC and terminal unit—let's call that a modem to more accurately reflect the transmit (modulate) and receive (demodulate) capability of these devices—into one box. Popular units from MFJ, Kantronics, and AEA can be seen in ads in this magazine.

Now, in the near future I hope to run information on modifying the Flesher TU-470 to run with some of the software TNCs. The clear answer is that it can be, and is being, done by many hams. This may well represent one of the most economical ways to get onto packet and, with some of the programs around, RTTY and even AMTOR, too! Thanks for the question, and good luck with the endeavor.

Model 42

Having corrected one, and answered one, now it's time to toss it out to you guys. I have a letter here from Eugene Matthews WØUAU from Topeka, Kansas. He writes, "I just acquired an almost new Model 42 Teletype (RO) machine, with power supply. I cannot find anyone who knows anything about this Model 42. I want to use this for hard copy. I need to know what connections to use to hook it up so it will print. Also, what current and voltage does this machine take to operate the selector magnets? The power supply is transistorized and must be 12 VDC output. What is the speed of this machine?"

Well, Eugene, the Model 42 is the end of the Baudot line, as far as I know. With a dot matrix output, it was able to accept TTL, current loop, or RS-232 interfacing. I believe that tape equipment was also available for this model. There was also a Model 43, which was the ASCII version of the Model 42. Buffered versions of this machine were available that could run at higher speeds.

I have no diagrams or specifics on the Model 42 or Model 43, but, somehow, I trust that someone out there in *73*-land will share some with us, real soon! Watch future columns for the information, as soon as it surfaces.

Along those lines, folks, here's a question from me to all of you. I have been looking, very unsuccessfully, for the round, six-pin mike connector for my Santec HT-1200 transceiver to try to get it up onto packet. If anyone has located a connector, and wiring information for this antique, I would appreciate hearing from you!

Feel free to contact me for this, or any other related (or non-related) matter at the address above, or on CompuServe at 75036,2501, Delphi at MarcWA3AJR, or America Online at MarcWA3AJR. I look forward to your comments and questions, and yes, the various software collections are still available. Send an SASE for the list, or inquire via Email and I'll Email a response back to you. A look at that Flesher modification next month, and maybe a look way, way, back, too! Suspense? I can't stand it. Just don't let your subscription to *73* lapse! You might miss RTTY Loop!

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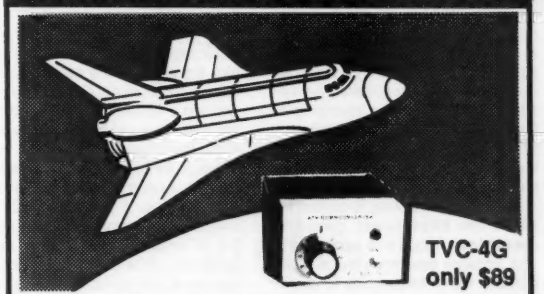

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More on the Boyd Sweeper

In the September column we looked at the Boyd Electronics RF sweep generator kit. This low-cost device provides CW, Symmetrical Sweep and Video modes. The CW mode operates like a regular signal generator, i.e. it outputs a single frequency for each setting of the 2-30 MHz frequency control. The symmetrical sweep mode is a variable-width swept frequency mode; the width of the swept portion is a function of the front panel settings. The video mode sweeps the entire HF range for every cycle of the sawtooth sweeping signal. In the original column I promised to discuss in the very next month's column add-on circuits that make the generator better. I didn't exactly lie, but other things came up that prevented me from putting that column together on time. This month, we'll keep that promise.

Three obvious improvements for any sweep generator project, including the Boyd unit are: an external step attenuator, a frequency translator for lower frequencies, and a marker generator.

The step attenuator is needed because the sweep generator outputs a rather large signal level . . . too large for easy testing of receivers and amplifiers in most cases. While the signal level will work well with some tuned circuits and filters, it is inappropriate for nearly any application that has amplification associated with it. A step attenuator (Photo A) provides switch-selectable levels of attenuation that can be in or out of the circuit as needed. In addition, the step attenuator will provide a swamping effect between the signal generator and the circuit under test in case the impedance of one or the other is not 50 ohms, or varies somewhat.

A frequency translator is needed because the Boyd sweep generator doesn't cover frequencies below 2 MHz. This limitation does not affect all hams because the IF frequencies in our HF rigs tend to be 8.83, 9.0 or 10.7 MHz . . . well within the range of the Boyd RF sweeper. But for those who need to sweep circuits below 2 MHz, including the once-standard 455 kHz IF frequency (used on Collins mechanical filters, even today), we need to be able to translate the Boyd sweeper's output to a lower frequency. We need a double-balanced mixer (DBM) and a crystal oscillator.

The marker generator is a standard crystal oscillator that allows known frequencies to be injected into the circuit for the purpose of calibrating certain spots on the band. For example, if you use a 9.0 MHz IF in your receiver, you might want to have a 9.000 MHz crystal oscillator to mark the spot on the oscilloscope presentation of the sweeper signal.

Step Attenuator

A step attenuator such as Photo A consists of several stages of pi-pad resistor networks, each of which can be switched into or out of the circuit with a DPDT switch or relay (Figure 1). Table 1 shows the values of resistors needed in the pi-attenuator for various popular levels of attenuation. Alternatively, if you want the attenuator to be a little more precise, then use Mini-Circuits AT-series fixed attenuators. These devices are designed to fit onto printed circuit boards and perf boards on the standard 0.100-inch center holes. The type number, AT-x, is formed by replacing the "x" with the level of attenuation desired; e.g. AT-1 is 1 dB, AT-6 is 6 dB, AT-10 is 10 dB, AT-12 is 12 dB, and AT-20 is 20 dB.

In order to obtain higher orders of attenuation, one need only series connect several lower order stages. For example, to obtain 40 dB attenuation, cascade two 20 dB attenuators, or a 20 dB and two 10 dB attenuators.

In some cases, you might want to use a barrel attenuator. These attenuators are in-line, fixed attenuators that have a male coaxial connector on one end and a female coaxial connector on the other. They can be placed anywhere in the transmission line from the signal source to the circuit under test, although in most cases the preferred location is right at the signal generator output. The attenuator male connector is attached to the RF output connector of the signal generator, while the coaxial transmission line to the load is connected to the female connector on the attenuator. These devices are also available from Mini-Circuits, but at somewhat higher cost than the printed circuit variety.

One thing that you must do when building a multistage step attenuator is to use real good shielding between successive stages. Any signal leakage around the circuit detracts from the attenuation value selected. The *ARRL Handbook for Radio Amateurs* for most years has an attenuator project. In one version of that circuit, pieces of copper-clad printed circuit blank material is used to fashion the walls and sides of the step attenuator compartments . . . and only one stage is inside each compartment. You can also use brass stock from hobby shops to fashion shielding. Such stock can be worked with ordinary tin snips, scissors (if you don't care about dulling them) and hand tools.

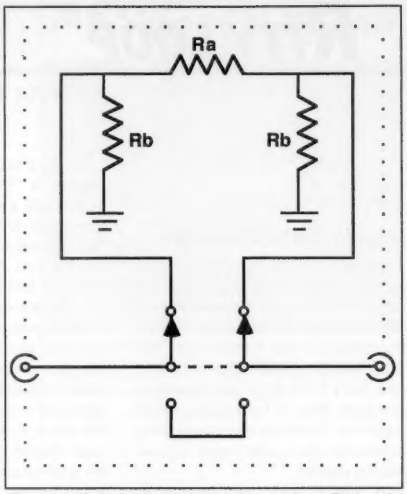

Figure 1. Switchable attenuator stage (see Table I for values).

Frequency Translator

A frequency translator to make the RF sweeper work below 2 MHz is relatively easy to build. The Mini-Circuits (P.O. Box 350166, Brooklyn NY 11235-0003) passive double-balanced mixers such as the SRA-1, SBL-1 and SBL-1-1 are easily obtainable, and well-behaved (i.e. they do what they are advertised to do). We've discussed these devices in this column previously.

You can also use the Signetics NE-602 double-balanced mixer IC device for the translator. The NE-602 contains a Gilbert transconductance cell DBM and a local oscillator stage, and has been covered previously in these pages.

Four features are needed to make the translator work in this context: a mixer device, a crystal oscillator, a high-pass filter terminated into a 50 ohm dummy load, and a low-pass filter that carries the output signal. The filters are necessary because the output of the DBM will be the sum and difference of the RF sweeper and crystal oscillator signals (F1 + F2 and F1 - F2). The sum frequency is not needed, so it is passed through a high-pass filter to be absorbed in a 50 ohm dummy load (actually, a 51 ohm resistor will do). The difference frequency is passed through the low-pass filter to a 50 ohm output terminal. It is probably smart to use a matched amplifier at the output of the low-pass filter because the mixer and the low-pass filter have insertion losses associated with them, and an amplifier will make up for that loss.

Figure 2 shows a circuit that can be used for this purpose. The RF sweeper input signal is fed to pin no. 1 of the DBM, which is its RF input. This signal must be kept below +1 dBm or the mixer might suffer harm. A series -3 dB attenuator is used to reduce the signal level. Even if the signal level is below the +1 dBm level, some people like to use the attenuator anyway because it provides a "swamping" effect against impedance variations. In those cases, a 1 dB attenuator can be used. Keep in mind that, for situations where the impedances are constant and the signal level is within range (below +1 dBm), the attenuator is optional.

The local oscillator circuit is a standard crystal oscillator circuit with an output amplifier to boost the signal level. Ordinary NPN silicon transistors can be used (2N2222, 2N4401, 2N3904, etc.) The mixer likes to see local oscillator signals in the +7 dBm range for proper conversion, which means, at 50 ohms, 5 mW power level or a peak-to-peak voltage of 700 mV. The crystal chosen can be anything in the 2 to 10 MHz region, so long as you can adjust the sweep generator to be within the difference frequency of the lowest sweep generator output frequency. I chose a 6 MHz crystal because it is one of the standard "microprocessor clock" crystals available at low cost from local parts sources. Crystal suppliers can make any exact frequency you need, or you can use one of the computer clock standard frequencies, or a 3.579 MHz color TV "color burst" crystal . . . all at low cost.

The output filters can be easily made from toroid coil forms or, if you prefer, standard coils obtained from parts suppliers. If you opt to use the toroidal cores, then use T-50-2 (RED) cores. These devices have an AL value of 49, so the following turns counts will suffice:

L1,L2	3.14 µH	25 turns
L3,L5	4.9 µH	32 turns
L4	8.5 µH	42 turns

The capacitors in the filter should be either silver mica or NPO ceramic devices, with the latter being preferred over

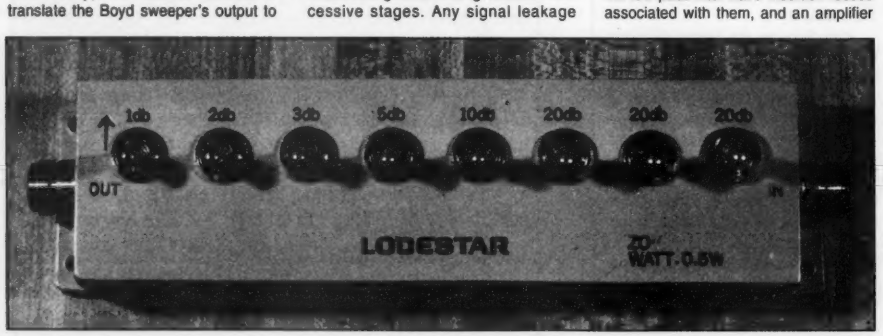

Photo A. Commercial step attenuator.

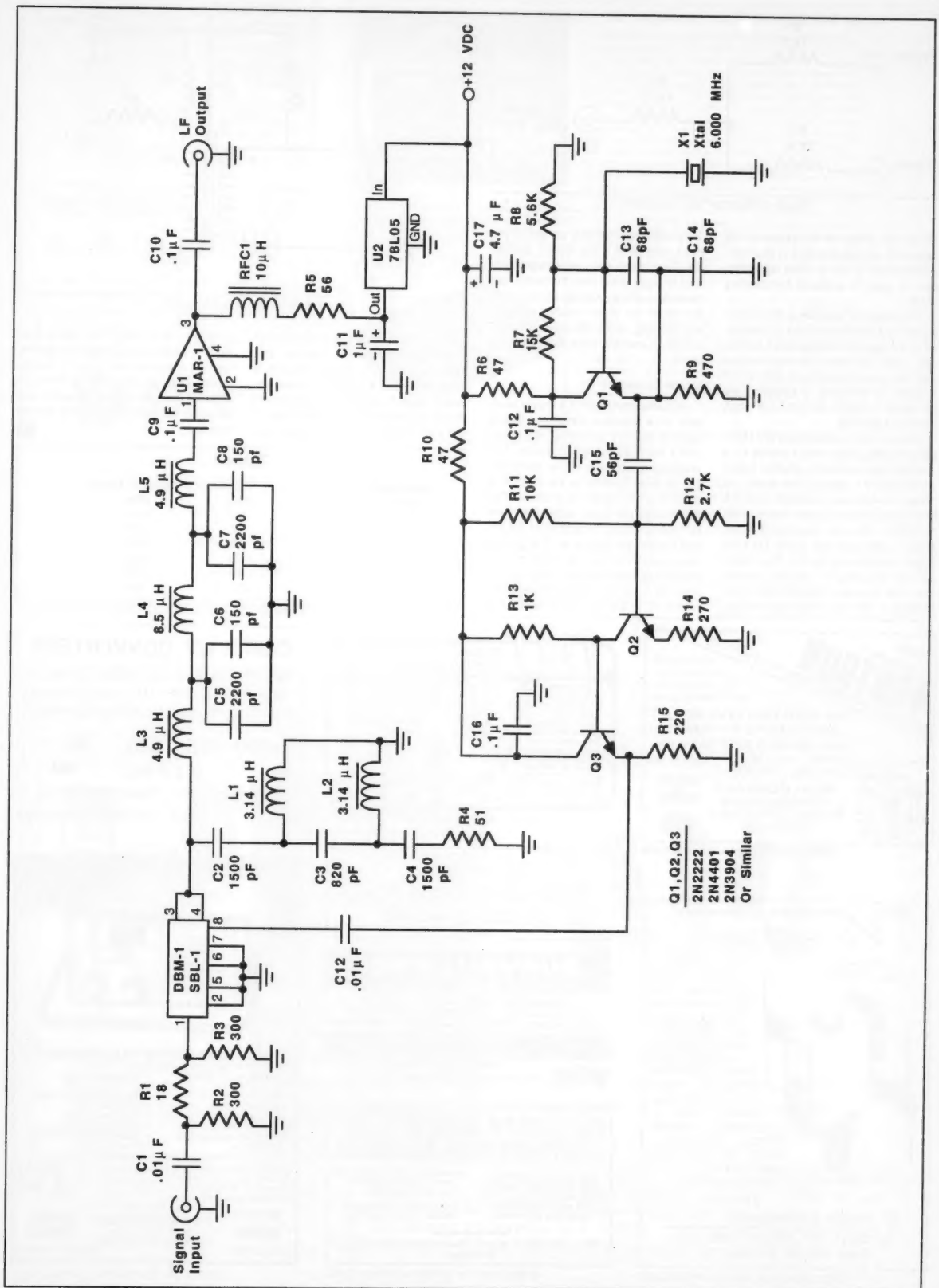

Figure 2. Circuit for a frequency down translator.

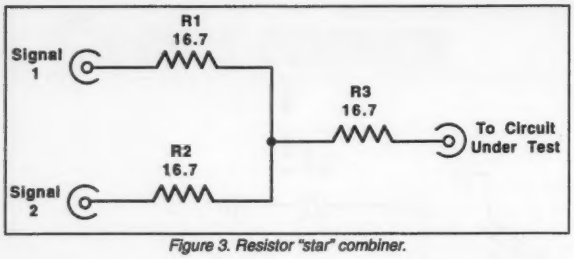

Figure 3. Resistor "star" combiner.

the former. Because the values of the capacitors are not standard in all cases, combinations of two or three capacitors can be used to achieve the desired value.

The output RF amplifier is the MAR-1 device by Mini-Circuits, and is connected in the standard configuration for that part. Note that there are input, output and two ground terminals, but no V+ terminal. In this style of amplifier, the DC power is fed to the MAR-1 through the output terminal.

[Note: I have a small stock of MAR-1 devices, and printed circuit boards for a 1 to 500 MHz wideband amplifier based on the MAR-1 device. The MAR-1 is priced at $4.95 each postpaid, while the boards are $7 each (order board MAR-1D.PCB). The two together, i.e. the MAR-1 chip and the MAR-1D.PCB board, are available for $10. The boards (but not the chip) can also be ordered from FAR Circuits (18N640 Field Court, Dundee IL 60118) for the same price. They sell other *73* PCBs as well. If you need more than a few MAR-1 devices (i.e. 20 or more), then you can get them a lot cheaper direct from the factory because you will go over the minimum order value. My price includes shipping and handling, and is offered as a convenience to readers more than anything else.]

Marker Generator

A marker generator is a crystal oscillator on a standard frequency that is used to identify points on the swept curve seen on the oscilloscope. Any reasonably accurate signal generator can be used as long as the method of combining the signals is provided. Two approaches are taken: either the resistor "star" combiner (Figure 3) or the hybrid transformer (Figure 4). The star resistor combiner can be made for any practical number of inputs. Each resistor must be 1/nth the system impedance, where "n" is the number of ports. For this circuit, the system impedance is 50 ohms (standard for RF circuits), and there are three ports, so each resistor is 16.66 ohms. As a practical matter, selected 18 ohm carbon composition resistors will suffice. Use an ohmmeter to find the 18 ohm, 5% resistors that are closest to 16.7 ohms. The hybrid combiner is based on a ferrite transformer. Use 12 turns on an FT-23-72 ferrite toroid. Alternatively, write to Mini-Circuits for their catalog of RF parts, and select a commercially-made hybrid combiner.

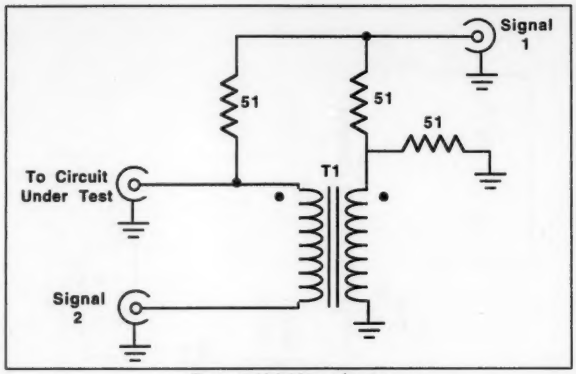

Figure 4. Hybrid transformer.

Table I

Attenuation (dB)	Resistance values in Ohms (Ra)	(Rb)
1	6.2	910
2	12	470
3	18	300
5	33	200
10	75	100
20	270	68

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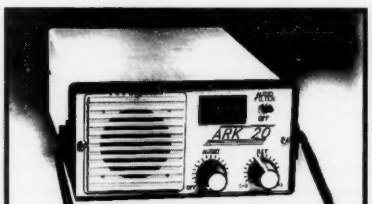

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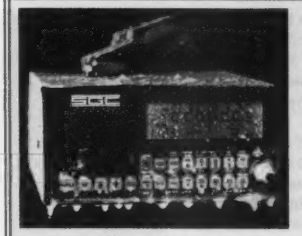

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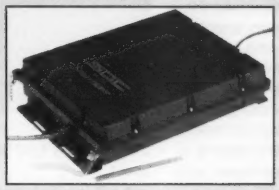

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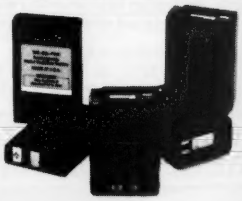

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A quad, yagi, or other radio direction finding (RDF) antenna is cheap, especially if you make it yourself from PVC pipe and wire or from scrap TV antenna tubing. Add an RF attenuator made from some toggle switches, carbon resistors, and copper-clad board, mount the beam on your car, and you're set. Such a setup is more than adequate to win many hunts, with practice.

However, like participants in any other sport, T-hunters are always looking for an advantage over the competition. Decades ago, they discovered that a polar display of signal strength versus direction gives a much better understanding of signal characteristics than an S-meter alone, particularly when hunting among tall buildings or hills that bounce and scatter 2 meter signals.

"Homing In" covered theory and advantages of polar displays in detail with actual trace photos in October 1992. KK6CU's home-brew mobile implementation of the scheme was featured in the following issue, complete with motorized quad and storage scope indicator. Now two T-hunters from Santa Barbara, California, have found a way for penny-pinching tinkerers to have a polar display and motorized beam without the expense of a storage monitor and the hassle and noise of RF slip rings.

Look! No Slip Rings!

Tom King KA6SOX works in marine electronics at the Santa Barbara harbor. Kerry Provancha KK6OS enjoys mechanical engineering challenges. Together, they created the RADAD, which stands for "RAdio Detection And Direction" (see Figure 1). As passers-by admired it at a recent ham radio swap meet, I interviewed them and they eagerly told me how it came about.

Photo A. Kerry Provancha KK6OS brought the RADAD to the TRW swap meet and unscrewed the covers to reveal the antenna turning mechanism.

KK6OS: "We were looking for a long persistence phosphor cathode ray tube (CRT) display, rather than a storage scope, because a storage scope needs to be cleared all the time."

KA6SOX: "I happened to get some junk marine radars. The magnetron transmitting tubes had croaked or the high voltage boards had gone up in flames. They're economically unrepairable for marine service because I can't get tubes or power supplies at reasonable cost. Fortunately, those parts aren't needed for RDF."

KK6OS: "Of course, the microwave transmitter, receiver, and horn antenna were of no use, but we retained the rest of the radar essentially intact. We changed the antenna drive motor because we wanted different rotation speeds (see Photo A)."

KA6SOX: "Sometimes we want to paint the RDF picture slowly and sometimes fast, depending on what the hider is doing. So we used a 30

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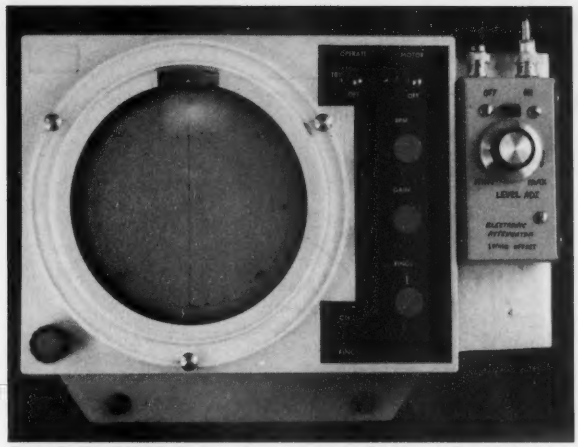

Photo B. The RADAD display unit mounts on the floor hump. Tom made a new front panel and mounted the RF attenuator box on a bracket for easy access.

volt DC motor and built a variable voltage inverter to control speed."

KK6OS: "It's difficult to find motors with adequate torque over a wide speed range. We use a DC gearhead type about 5 inches long, about 100 inch-lbs. torque."

KØOV: "How did you make the radar scope show 2 meter bearings?"

KA6SOX: "It was very simple. All the CRT power supply and sweep circuitry is already there (see Photo B)."

KK6OS: "The electronic yoke in the display follows a resolver, which is geared to the antenna (Photo C). Whatever speed the resolver goes, the yoke on the CRT follows exactly. There is no mechanical stuff in the yoke."

KA6SOX: "As the antenna turns, the yoke sweeps the CRT electron beam in a circle. In addition, the radar control head generates a linear voltage ramp that sweeps the beam from screen center toward the edge at about 200,000 times per second."

KK6OS: "We compare receiver S-meter voltage with the ramp voltage. The comparator triggers a one-shot to produce pips, replacing the radar pulse. It pulses the CRT cathode negative for 1.5 microseconds. The S-meter voltage compared against the ramp determines how far out on the screen from the center you get pips. The resolver tells where on the azimuth circle to put the pips."

KØOV: "So at 200,000 pips per second, it looks like a continuous line is being drawn on the screen."

KA6SOX: "Right. Full scale on the S-meter equals maximum deflection to the edge of the screen. The interface was done with one LM339 quad op amp IC."

KØOV: "What about your antenna design?"

KA6SOX: "We went through about a half dozen iterations of the antenna."

KK6OS: "We tried to make one that would fit inside the radar's plastic radome so there would be no wind-loading. But it was a negative gain antenna without a decent pattern. It would probably work on 450 MHz, but not on 2 meters."

KØOV: "So you made a full-sized 2 meter beam to get good sensitivity?"

KA6SOX: "Yes. We solved the rotary joint problem by using an AEA half-wave whip antenna as the fixed-mounted driven element. The directors and reflectors rotate around it. It gives a beautiful pattern."

KK6OS: "There are no slip rings. The driven element mounts on a BNC that never rotates, so it's noise-free (see Photo D). The coax goes right up through the center of the waveguide where the radar output used to be. The antenna is a three-element yagi, made of a PVC pipe upright and crossbar. Two directors and a trigonal reflector rotate around the driven element. It's all painted stealth black and sits on a rack that bolts to the car-top carrier (see Photo E)."

KØOV: "Was the trigonal reflector used for a better pattern or for mechanical balance?"

KA6SOX: "Both. We had a single reflector at first. When we changed to the trigonal reflector, the lobes on each side dropped by 5 dB and the back lobe completely disappeared. We measured 0.7 dB more gain, too."

KK6OS: "Now the antenna was mechanically balanced almost perfectly."

KA6SOX: "But we discovered that mechanical balance is not the same as windload balance. Even with the triple reflector, when we were going down the road at 40 MPH, it would stall. We then added a small fin on the back. Now we can drive up to 55 MPH with no problems."

KØOV: "How do you shrink the display size as you close in?"

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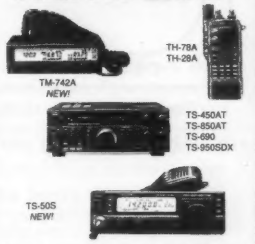

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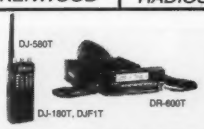

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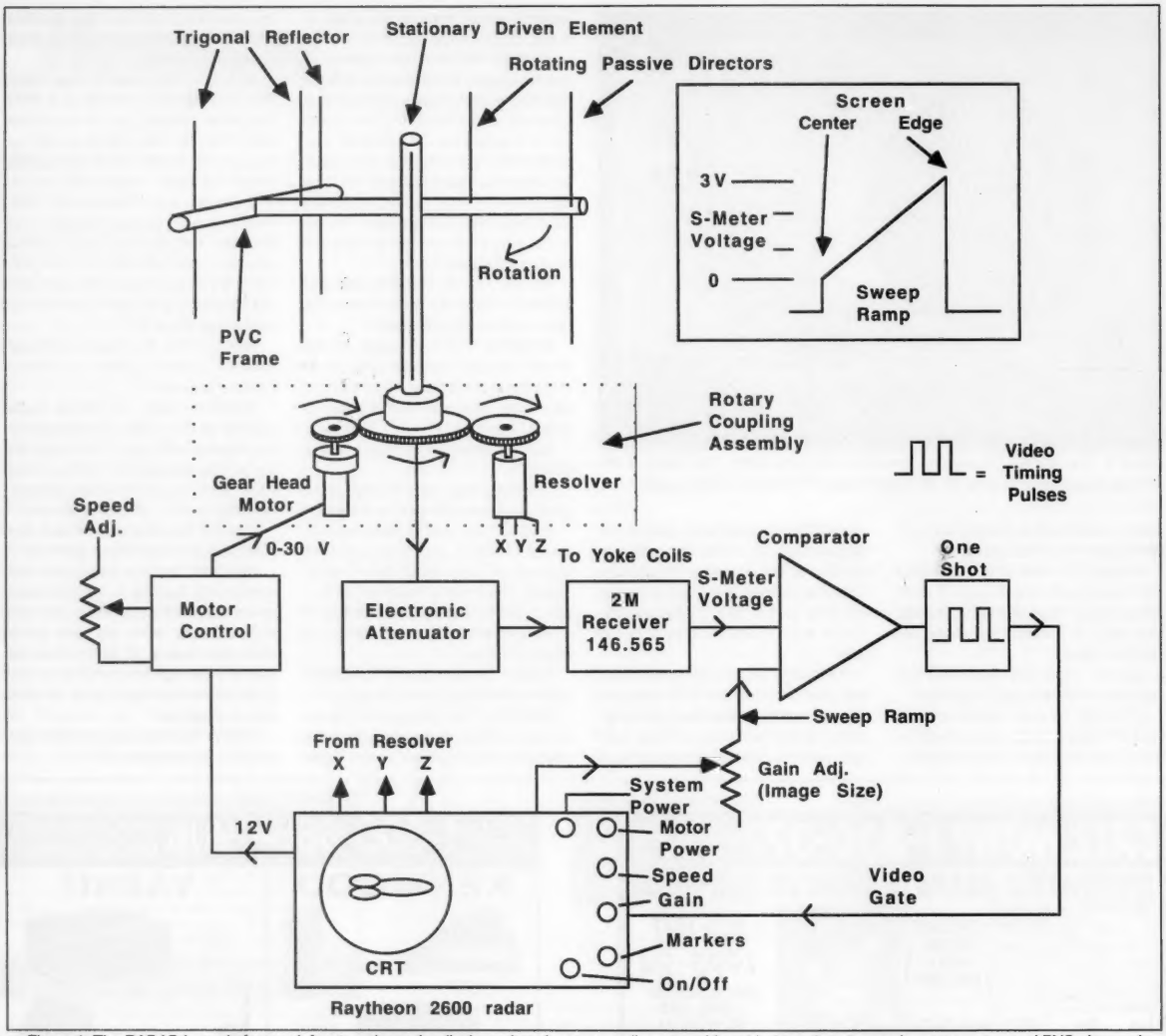

Figure 1. The RADAD is made from a defunct marine radar display unit and rotary coupling assembly, added to a 2 meter receiver, attenuator, and PVC pipe yagi.

KA6SOX: "With an RF attenuator. It's based on the offset attenuator in *QST* for November 1992. We changed the offset to 1 MHz and use a crystal-controlled oscillator, plus better shielding."

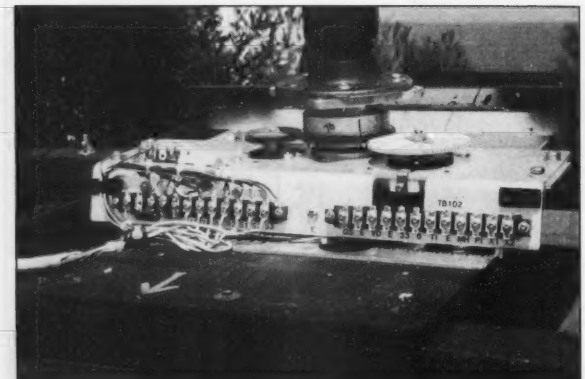

Photo C. The 30 VDC motor is geared to the rotating antenna mast and the resolver. Inside the mast is the old waveguide, which holds a stationary driven element.

KK6OS: "The continuously variable electronic attenuator has been the biggest single improvement to the whole system. It makes it easy to keep the display on screen. Before that, we used a switchable resistive attenuator, which was hard to use because of the large step sizes."

KØOV: "Tell me about hunts in Santa Barbara."

KK6OS: "We have all kinds, including mileage hunts (lowest odometer miles wins), time hunts (first finder wins), and combination time/mileage hunts. The hider decides. Most are time-only. We hunt on the fourth Saturday night of the month on 146.565 MHz."

KA6SOX: "A few months ago, the hiders wove the antenna inside a volleyball net at the beach. They used RG-174 coax, painted the color of the volleyball tape along the bottom. It was then painted yellow along the pole all the way down into the sand, where the transmitter was buried, running about 50 watts. I'm pretty sure the vertical pole was a non-tuned reflector. We found the general area easily, and the hiders were sitting right there roasting wieners. The big problem was finding the antenna and the radio."

KA6SOX: "Some T-hunts in Santa Barbara have become absolutely insane. They're not like Los Angeles All-Day hunts, where the T is miles and miles away. But dirty tricks by the hiders are allowed. They do all kinds of weird things, like swinging beams and hiding multiple T's."

KK6OS: "I started it, I guess. On one hunt, we synchronized two transmitters. When one came on, the other one went off, and so on. They were on two different mountaintops. We were trying to screw up the Doppler users so they would get an indication that went this way, then that way. My former T-hunt partner has the control box for the synchronized T's and he likes to use it. Other hams have come up with their own schemes for doing it, too."

Photo D. Marine radar technician Tom King KA6SOX has taken off the yagi frame with parasitic elements and is holding the top of the driven element whip.

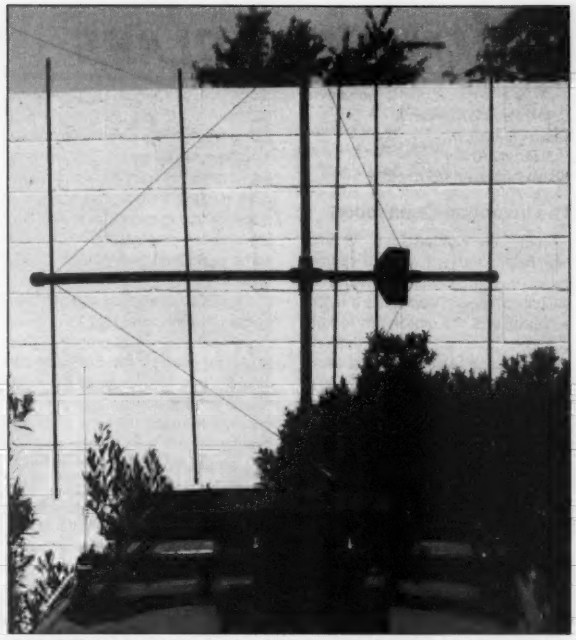

Photo E. This lightweight vertical yagi with trigonal reflector has good gain and an excellent pattern, yet spins up to 140 RPM while the car moves at 55 MPH.

KØOV: "Have you won any hunts with the RADAD?"

KK6OS: "I won with it in June, so I hid in July. When I hid, I used the spinning RADAD antenna in a parking garage downtown. I set the antenna unit on the floor at a middle level of the garage, rotating at 20 RPM. I transmitted 5 watts SSB modulated with a pulsed 500 Hz tone, a quarter second on, then a half second off. I was trying to make the Doppler RDFs go wacky. It didn't do that, because one guy found us in 15 minutes. But another hunter ended up dozens of miles away in the wrong direction from the start, and three teams gave up without finding it."

KØOV: "So your system does a great job finding tough T's, right?"

KA6SOX: "It's still experimental. We don't consider it to be a breakthrough, but it's quite a step forward in distinguishing what is a signal reflection and what is not, which the Doppler cannot do when the two are equal in level. However, it requires a skilled operator to interpret it."

KK6OS: "Up here in Santa Barbara, hunters often pulse the signal. If they picked just the right pulse rate and our antenna was going at just the wrong speed, the CRT screen became useless. On a couple of hunts, I was pulling my hair out. I could not get a bearing, because they were pulsing exactly three times for every rotation of the unit. Since then, we changed the motor control to cover 0 to 140 RPM. With the long persistence P7 CRT at night, you can see 15 to 20 traces superimposed at 140 RPM."

KØOV: "What radar models do you recommend for readers who want to make their own RADAD?"

KA6SOX: "Models 2600 and 2800 are the best. Raytheon designed and imported them, but they were made by Japan Radio Corporation. They're also known as the Mariner's Pathfinder. They were produced between 1970 and 1976. Raytheon sold 35,000 of the 2600s worldwide, and around 8,000 of the 2800s.

KØOV: "Are these radars available?"

KA6SOX: "Sure, but who knows how many are still in service and how many are at the bottom of the ocean! They have longer service life than most radars of the '70's because they don't have a rotating yoke assembly to fail. There are probably 35 or 40 still in use on the thousand or so boats in Santa Barbara harbor. I saw a used one being installed on a boat about three weeks ago."

Let's Try It

After the swap meet, I rode along as Tom and Kerry demonstrated the RADAD on a beginners' hunt sponsored by the TRW Amateur Radio Club. The system worked smoothly and quietly, giving excellent scope patterns. In just a few minutes, we arrived at a parking lot where the hidden signal was super-strong.

None of us had brought "sniffing" equipment, so I tuned to the third harmonic of the hidden T signal with my dual-band handheld, got a bearing by body shielding, and started walking. Five minutes later, I tracked down the antenna 15 feet up in a tree.

Tom and Kerry have found a simple, yet elegant scheme for feeding a continuously rotating beam. Waterproofing is easy and there are no slip rings to make noise or cause losses. The main disadvantage is that only vertically polarized yagis can be fed in this manner, a problem in areas where hiders are allowed to use horizontal polarization.

You can't buy a RADAD, but if you're a knowledgeable builder, you can assemble a similar system. With careful scrounging, you'll preserve your T-hunting gasoline fund. It's time to hit the swap meets and make friends with your local marine electronics tech! 73

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The Invention Connection

In the July 1992 edition of *73 Amateur Radio Today*, I wrote a column called "Invention Versus Innovation." I discussed different techniques a teacher can use in the classroom to help children develop inventive thinking skills. Amateur radio in the classroom allows the teacher to bring out the very best in creativity and analytical skills in the students. I received an excellent response to this column from other teachers who shared their experiences with me after following some of the suggested activities.

One of the interesting letters I received was from William L. Enter, Sr., KB5NUA, founder and past president of the "Invention Development Society, Inc." He points out that inventing is a prized human trait. It sets one apart from others in a unique way. Few people develop their ideas to the practical stage and still fewer to the patenting stage. Congress created the Patent Office in 1836, yet the five millionth patent was granted only last year.

William holds three U.S. patents and has invented at least 58 electronic circuits. He says there are many opportunities for young minds to benefit from an invention program. "We could use some new electronic circuits," says William.

He has been working with the Oklahoma Student Inventors Exposition since April 1982. This program is designed for grades K-12. Statewide participation has annually been as high as 4,428. The organization teaches teachers how to teach thinking skills and problem-solving skills to their students. The students learn to do analytical thinking and creative problem-solving on a daily basis in all subject areas. The children are then required to research their community for an unmet need and to invent something which serves that need. They must produce a novel response that solves the problem at hand. Their inventions must be a simple, elegant, aesthetic solution to a real everyday problem. Kindergartners tend to do better than 12th graders. I'll bet that most of the teachers reading this column recognize why that is so. One of the necessary traits to being truly creative or inventive is to have a mind-set that is basically uninhibited. Younger children seem more apt to have that.

Photo A. Richard Starks, 1990 Grand Prize Winner, shows "The Stick-Um Fly Swatter."

There is a National Creative and Inventive Thinking Skills Conference every year, held in a different city each time. If you would like more information about the conference or about the Oklahoma Student Inventors Exposition, contact Ms. Betty Wright at (405) 670-3131. She is a Regent for Oscar Rose State College in Oklahoma City, and has a TV show called "Math Counts." She teaches gifted and talented children in the Oklahoma City schools. The "Guidelines" brochure for the contest is free to Oklahoma teachers; $1 postpaid for out-of-state orders. There is a price reduction for 10 or

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Photo A. The Honorable Governor (Oklahoma) David Walters issues "Governor's Commendations" to the top eight winners (and their teachers) of the 1993 Oklahoma Student Inventors Exposition.

more. The organization has a 501(C)3 tax-exempt status.

The Teacher's Role

William Enter has volunteered to speak with anyone who has questions at (405) 376-2362. William says he believes as I do that the teacher is the one who must set the environment for youngsters to feel free to explore, to experiment, to question, and to discover. It takes a special kind of teacher to get the point across to children that it's okay to be wrong or to fail at something once in awhile. What's important is that burning desire to keep on trying and to experiment with new ideas.

There are three great quotes that are good to use with children in a classroom setting. It's always fun and enlightening to ask the kids to explain the meaning of the quotes:

"A child is someone who will take over what you have started"—Abraham Lincoln.

"Imagination is more important than knowledge; for imagination embraces the world"—Albert Einstein.

"Man's mind, when stretched over a new idea, will never return to its original size"—Thomas Jefferson.

I've been teaching "Introduction to Amateur Radio" to sixth, seventh and eighth graders for more than 13 years now, and I am always amazed at the creative and inventive projects the children do in the radio program. I often invite guest speakers in to my classes. Many hams that we speak with on the air are more than willing to come to the school and share their experiences with the kids about things they have built or created in their shacks. It's a great motivator!

Please write and let me know if your class has a future Edison in it. Let's share ideas that are successful; ideas and activities that motivate children to be creative are what we're all looking for. You can always get good ideas on the "CQ All Schools" net with Gordon West WB6NOA and myself on Tuesdays and Thursdays at 12:30 EST on 28.303 MHz, after 10 minutes try us on 21.325 MHz. We'll be listening for you! 73

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Low Power Operation

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Small, crystal-controlled transmitters like the Ryan Communications exciter described the other month are great fun. Crystal control does have one drawback, however: You're stuck on one frequency.

At first I was working on a simple VFO for the Ryan exciter. After a few days on the bench, my simple VFO became rather complex. My Ryan exciter is on 30 meters, so the need for a wide frequency swing seemed like overkill. A better, and perhaps simpler, way to move around the 30 meter band was to swing the *crystal's* frequency—a VXO. The Ryan exciter's oscillator will not allow VXO operation as is, so I tried several different variable capacitors in series with the crystal, with lackluster results. I then tried building a completely new and different oscillator on a small piece of perfboard. I really did not want to make major changes to the Ryan exciter, so I built a second board containing the VXO.

The oscillator is broadband, thanks to T1. An 2N5179 will develop more than enough umph to drive the Ryan exciter. If you don't have a 2N5179, a *metal* case 2N2222A will work fine, too. The output of Q1 goes to the broadband transformer T1. The primary of T1 consists of 20 turns of #26 enamel wire on an FTP37P43 core. The center tap is at 13 turns from the collector end of T1. The secondary has four turns of #26 wound over the entire core. Don't bunch this secondary winding all up on one end of the core—spread the turns over the entire core.

The resistors on the output of T1 place a slight load on the oscillator. A 0.01 µF capacitor couples the output from the oscillator into the Ryan exciter.

You can use any variable capacitor for C1 as long as you don't go over 50 pF. Use a good quality capacitor for C1 as you'll be running it back and forth through its range a great deal. A double-bearing capacitor would be grand, but they are kind of hard to find. Check with KA7QJY Components (P.O. Box 7970, Jackson WY 83001) for his list of variable capacitors.

The crystal used for the VXO should be a fundamental crystal in an HCP25/U holder with a parallel resonance of 20 or 30 pF. Don't get high tolerance crystals—tolerance of 0.01% is fine for the VXO. Crystals mounted in the FT-43 holders do not work well with VXO circuits.

There are two methods of getting the oscillator to talk to the Ryan exciter. Either one will work, and both require some changes or additional circuitry to work.

The best method is to re-work the crystal oscillator of the Ryan exciter to work with the new oscillator. I tried to couple the new oscillator into the base of the Ryan oscillator. This will work if you're really into milliwatting (I was only able to get about 300 milliwatts from the exciter).

To get full exciter output you'll need to change some components in the Ryan oscillator. The first step is to change the 820k resistor on the base of the oscillator transistor, 2N4124, to 10k. Remove the 270 pF capacitor from the base of this transistor, too. These two changes now make the oscillator on the Ryan exciter into a buffer/amplifier. You can still key the exciter as usual by grounding the emitter of the 2N4124. Connected this way, the output of our VXO, coupled to the base of the 2N4124 on the Ryan exciter, will provide operation exactly like a crystal-controlled exciter.

There is one catch in running the VXO and Ryan exciter this way: You have to keep the external VXO running all the time. You key the Ryan exciter by grounding the emitter lead of the 2N4124. This normally keys the crystal oscillator. Since we've changed the oscillator into an amplifier, the external VXO must run continuously. There are two fixes to this problem. First, just key the Ryan as usual and let the VXO oscillator run all the time and remove power to it during receive. Or, you can short the key line on the Ryan exciter and key the VXO. To key the VXO, you'll need to add a keying transistor in series with the VCC line. A simple 2N3905 will suit the bill here. I went into a bit of overkill and used a 2N4037 to key the VXO.

Since you may have to add the keying transistor to the VXO oscillator, you can then use a second method of coupling the output of the VXO into the Ryan exciter without swapping out parts. Simply couple the output of our VXO oscillator into the Ryan exciter directly to the driver transistor. Add the VXO drive directly to the base of the 2N5089 driver on the Ryan exciter. When you do this, you must key the VXO as the driver will amplify whatever it sees and pass it to the final. You can key the VXO oscillator and you don't have to mess with the Ryan exciter except for one shielded cable from the VXO.

Add an Amplifier

Because you'll not have the benefit of the extra stage of buffering between the VXO oscillator and the driver stage, you may want to add a small buffer amplifier. I have not tried this but it seems like a good idea. The schematic shows such a circuit taken directly from the *QRP Handbook* published by the ARRL.

This is an easy project to build on perfboard—a PC board isn't necessary. Just keep component leads short and direct. Test each circuit before you start on the second one. Be sure you have the Ryan exciter running on a crystal before you start removing parts from its circuit board. Remember, when your soldering iron hits the PC board of the Ryan exciter, the warranty goes up in smoke.

There you have it. VXO operation for the Ryan exciter. This will really bring out the QRP bug now that you are no longer rock-bound. 73

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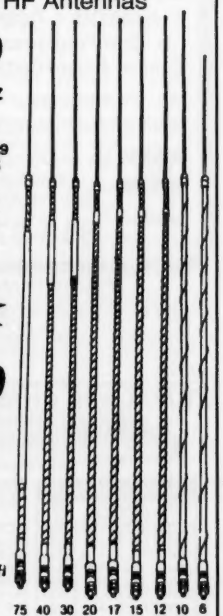

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Getting Started in TCP/IP, Part 2

Last month we started a series of articles on TCP/IP over ham radio, including how to do it. The first installment explained what TCP/IP is, and why it has advantages over the more familiar AX.25 "packet" protocol that most hams use. This month we'll talk about what you need to set up a working TCP/IP station and where to get it.

TCP/IP (Transport Control Protocol/Internet Protocol) is a way of moving various sorts of data in various sorts of packages. Associated with "IP" are a number of protocols for moving mail, bulletins, and data files—as well as ways of connecting for real-time discussions. We'll explore all of these in this series. First, of course, you need to be able to connect to the world of IP. What do you need to do this?

The "normal" packet radio protocol (AX.25) is usually built right into the hardware that a ham buys for "packet." The TNC (Terminal Node Controller) has a small processor and some firmware in ROM (Read Only Memory) that can talk right to a dumb terminal and radio. All that is needed is to connect the pieces together with the appropriate cables and the station is on the air.

While TCP/IP uses pretty much the same pieces as an AX.25 station, the jobs get switched around a bit. Though the AX.25 station frequently employs a computer as the dumb terminal, it doesn't need to. Anything that can "speak" RS-232 will work. For an IP station, though, the computer takes over most of the "thinking" from the TNC. The IP software puts the TNC into KISS (Keep It Simple, Stupid.) mode and handles all of the protocol business.

The Computer

Just how much machine do you need to run IP? The answer to this question varies a great deal, depending upon what you intend to do. TCP/IP stations run the gamut from single-user setups that only operate as clients—users of other stations—to full-blown multi-service hosts (PBBSs). Nearly any computer is capable of operation in the first category. Variations of NOS (the original TCP/IP software from Phil Karns KA9Q) are available for just about every personal computer, and for UNIX on many platforms. Because of the overwhelming likelihood that you are using an MS-DOS-based computer, that is what we will concentrate on. However there are also versions for the Amiga (another popular computer among hams) readily available. In addition, the program we will discuss most—JNOS from WG7J—is available in source code form. If you can use a C compiler, you might just be able to whip up a version for your own machine.

NOS and its variations are designed to be multitasking. That is, they run several *processes* simultaneously. In practice this means that there are separate, tiny programs doing a variety of things—apparently—at the same time. Since there is only one processor in your machine, what is really going on is a time sharing affair. Process 1 uses the CPU, then process 2, then maybe process 3 or even 1 again. From the user level the events that result from these processes appear to occur at the same time.

All this activity requires as much memory as it can get. Unfortunately, the versions of NOS that you can get today are not capable of using extended or expanded memory. They *will* use as much of the first 640K as you can give them, though. So, the first requirement for the IP station PC is 640K base memory.

As you might have guessed, multitasking is very CPU-intensive as well. This means that an IP station PC will be happier with a faster CPU. The simple rule is: The faster the better. Slower CPUs will produce various sorts of errors when they are loaded down with IP activity. Remember that the IP station must listen to you and the radio at the same time as it does its housekeeping. The station's use determines this load. A full-service host will run reasonably well on a 286/12 computer, but much better on a 386/25.

The programs and data files needed to run NOS are not that large. You could conceivably run an IP station on a floppy-based machine. On the other hand, even a small hard disk is a big improvement. Also, if you intend to run a full-service host, you will probably want to offer files for FTP (File Transfer Protocol) download. You'll need someplace to keep these.

The TNC

A TNC for IP station use does not need to be anything special. Basic IP operations at 1200 baud on VHF/UHF can be done with any TNC that offers KISS mode operation. The least expensive boxes, like the PK-88 from AEA, do just fine at this. However, if you are in a high activity area, or want to run a full-service host on a "backbone," you'll want to consider fancier options.

Most activity in the digital ham radio world today run at 1200 baud. This is the normal data rate for AX.25, and is standard on just about every TNC you can buy. Higher data rates are generally more desirable, but 1200 is entrenched. The backbones, though, usually run at 9600 baud or faster. There is a trend to faster user port speeds with a considerable contingent proposing a just right to 9600 baud. How does this affect your choice of TNC? Just keep this in mind, and think about something that can be upgraded to a higher speed, even if you don't do it now.

The Radio

As far as radio choice is concerned, IP adds nothing to the requirements. A good choice for packet is a good choice for IP. When looking for a radio, keep these requirements in mind:

Choose something modern. While a used radio is just fine, it should be a newer model if possible. Digital radio requires the radio to switch from receive to transmit very frequently. The delay in going between modes is called "switchover" time. This delay needs to be as short as possible to ensure good performance.

Choose something powerful. Though you *can* use a handheld for packet or IP, it is a risky proposition. For a radio LAN (Local Area Network) to work right, every station (called a node in LAN terminology) must be able to hear every other. With a low-powered station on the net, disruption and unreliable connections are likely. The power requirement varies with the particular LAN. The further the nodes are spread geographically, the more powerful the transmitter needs to be. If you are thinking about using an amplifier on a handheld, consider this: It may not switch fast enough to work at higher speeds. While even COR (Carrier Operated Relay) style amps usually work at 1200 baud, at higher speeds the switchover time of many amps will be too long.

Choose something sensitive. This is just the flip side of the powerful requirement. A sensitive receiver will help to improve the station's performance on the LAN.

Choose a good antenna. With good "ears" your receiver and transmitter will operate more efficiently. You need an *omnidirectional* antenna, NOT a beam. Remember, all the other stations have to be able to hear you for things to work right. A beam is only appropriate in a limited number of cases. Put the antenna up as high as you can and use good coax—remember that loss goes way up with frequency.

The Software

The rest of the articles in this series will discuss installing, configuring, and maintaining JNOS—a full-service variation on KA9Q NOS. The executable is for MS-DOS-based machines, and is frequently updated by the author, Johann WG7J. I chose to use this implementation for several reasons:

It is popular.
It is widely available.
It has a stable working version with very few bugs.
It has all the features needed for a full-service host.
It will work as an Internet gateway.
It has a reasonably good user interface.
I am using it here.

JNOS offers all of the host and client services currently available for amateur TCP/IP. For the end user, it offers a decent user interface, a split-screen terminal for AX.25 connects, POP mail (more on this later), and up to nine concurrent sessions with hot key switching. For the PBBS operator, JNOS offers superb mail connectivity (normal packet mail plus SMTP and POP servers), excellent security.

My choice of JNOS should not be construed as disparaging to any other NOS implementation. There are lots out there, and all have strengths and weaknesses. Each implementation is slightly different, so I had to choose just one. If you have a machine for which JNOS is unavailable, don't fret. You can get the source and compile a version—or you can find something else that works. While another implementation will not be identical, above the detail level you will still find the information presented here useful.

Getting JNOS

We will be working with JNOS version 1.07b. I will offer two ways to get it but, with a little ingenuity, I am sure you can find it elsewhere. First, if you have anonymous FTP access to the Internet, you will find the MS-DOS executable and source at:

ucsd.edu

In the directory:

\hamradio\packet\tcpip\jnos

The files are:

jnos107b.exe (executable)
jnos107b.zip (source)
jnosdoc.zip (documentation)

Get the executable and documentation files. If you want to compile a special version, get the source. (NOTE: If you don't know what "FTP" is, don't worry—just go on to the next option.)

The second way to get the files is from the *73* BBS. Be warned that the BBS can only do 2400 baud, so this will take awhile. The *73* BBS can be reached at:

603-924-9343 (8N1)

When you connect, follow the instructions and provide the requested information. When you get to the main menu, choose "F" for file area, and "9" for packet. The executable and documentation will be there.

Next Month . . .

. . . we'll actually install the software and start to configure it. While it is not a trivial operation, I imagine many of you will be on the air at that point. In the meantime, you might just try getting on the air without my help. Don't let it frustrate you: The docs can be confusing and the setup is not intuitive. Good luck! 73 de N1EWO. 73

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The N8EWV R/C Plane

Thanks to the ever-shrinking size of ATV transmitters and TV cameras, a number of enterprising ATVers have been successful in flying their systems onboard modest sized R/C aircraft. This month I'd like to share some of the innovations that Larry Hillier N8EWV of Beloit, Ohio, has designed into his R/C ATV plane.

Starting out with plans for a Hobby Lobby Telemaster (eight-foot wingspan), Larry built his plane from scratch, eventually adding wing tanks (half-gallon fuel capacity) to his current plane to allow for extended flight. The original model was powered with a four-cycle Enya 120 engine, but has been replaced with a 1.6 hp Zenoah 23 two-cycle gas engine (essentially a converted chain saw engine). This new engine allows him to use an inexpensive gas/oil mixture instead of the very expensive glow fuel common to most R/C planes.

The ATV Section

Larry installed most of the ATV equipment in the rear of the plane. His system consisted of a P.C. Electronics TXA5-RC 1 watt transmitter, an FMA5 audio subcarrier board and a Canon UC-1 color camcorder. The camcorder was placed just under the wing in the cockpit, facing out the side window. Larry can control the viewing angle of the camera through the use of a servo which moves the camera from the horizon to about a 45-degree downtilt. Since he uses a Futaba six-channel PCM R/C controller (50 MHz band), he had some extra channels to control the camera angle and to turn the ATV equipment on and off remotely.

Airborne Simplex Repeater

In addition to his ATV station, Larry put an ICOM 2AT and a U.S. Digital simplex repeater controller in the front section of the plane. With 32 seconds of recording capacity (in the high quality audio mode), the plane now acts as an airborne repeater during each flight. Since the simplex repeater is set up on the ATV calling frequency of 144.34 MHz, this works well in alerting area ATVers that the airplane is up and flying.

Larry has had some very long-range contacts using the plane as a repeater. Several stations as far away as West Virginia (over 100 miles away) have worked through the plane during some recent flights. Since there was some confusion as to the operation of a simplex repeater, Larry now operates the repeater with an output on 144.34 but has the input 600 kHz up on 144.94.

The Antenna System

Since he has a variety of transmitters onboard the plane, Larry had a real challenge deciding where to place his antennas to reduce interference to his R/C receiver. He finally mounted an Old Antenna Labs Mini-Wheel antenna (omni-horizontal ATV) under the plane just below the tail. The 2 meter antenna consists of four radials strung along the fuselage and into each wing. The driven element is a 5/8-wave length of piano wire that dangles just below the landing gear. This flexible piece of wire simply scrapes harmlessly along the ground during takeoff and landing, but pops out directly under the plane during flight.

After providing the maximum separation for the antennas, Larry mounted the two transmitters and the R/C receiver as far apart as possible. He also shielded the R/C receiver. The final configuration had the ATV transmitter in the tail of the plane, the R/C receiver in the middle and the 2 meter simplex repeater in the front. He can now fly the plane so far from him that it is a mere speck in the sky without any loss of control due to interference.

Long Duration Flights

Larry often flies his R/C ATV plane right around sunrise and sunset. He has received numerous reports of excellent video from stations all over northeast Ohio. Many of the reports come in via the onboard simplex repeater. There's nothing like creating your own 500-foot tower to increase your ATV range!

Now that he has a half-gallon fuel tank, he can fly for upwards of 1.75 hours. His most recent duration attempt flew for 1-1/2 hours and he still had 20 ounces of fuel left! At the end of September (the month this column was written), Larry plans to fly his plane over a 60-mile path from near Warren, Ohio, all the way up to the shore of Lake Erie. He will follow along underneath the plane while riding in the back of pickup truck with a TV set and R/C transmitter. He plans to keep the plane in sight (both visually and via ATV) throughout the flight. Since the plane is capable of 55 mph airspeed, there should be more than enough fuel for the whole flight.

Larry is planning another R/C ATV plane. This one will be a seaplane with the engine mounted above the wing. There will be a movable nosecone that will contain the TV camera and will allow the camera to pan up and down (similar to the Concorde's nose sec-

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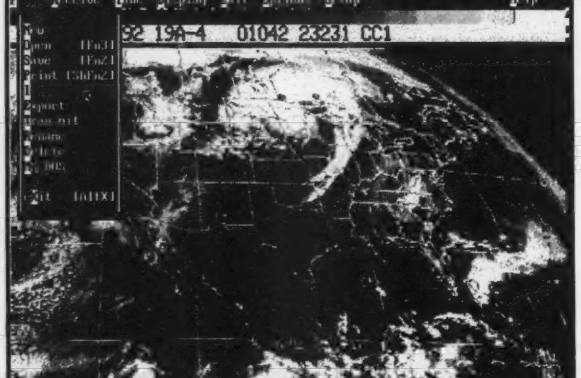

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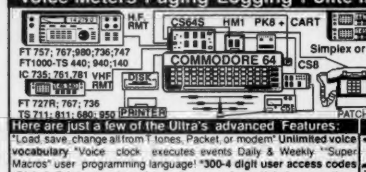

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Photo A. Larry Hillier N8EWV with his eight-foot wingspan model airplane. This plane includes a live camera ATV system as well as a simplex 2m FM repeater.

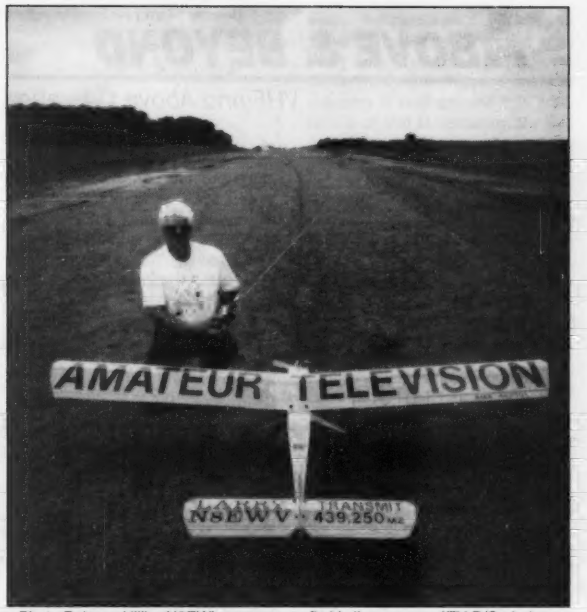

Photo B. Larry Hillier N8EWV prepares to fly his live camera ATV R/C airplane.

tion). The camcorder controls will be remotely controlled via fiber optic lines to a touch-tone decoder, so that all functions including zoom can be operated from the ground.

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If you are traveling through northeastern Ohio and would like to talk with Larry N8EWV about his ATV plane, you can usually find him, as well as the local Youngstown/Salem, Ohio, ATV group, working through the KD8PE ATV repeater during their weekly ATV net every Thursday evening at 9 p.m. local time. The KD8PE ATV repeater is located on a 190-foot tower in Beloit, Ohio (439.25 MHz input/426.25 MHz out). They use 144.34 MHz for their ATV talk frequency. Also, a number of the ATVers in the area monitor the high profile 146.865 (-600) repeater.

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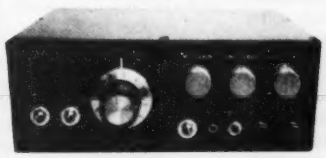

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Microwave Construction Practices

Let's continue where we left off last month when we covered the construction of a basic SSB system. This month I would like to continue with the construction of some basic elements. I will be going into detail on construction techniques for successful projects, describing some useful tools. A lot of questions need to be answered for those just starting a project—but not all can be anticipated. However, with luck, this column should put some of the construction detail questions to rest.

Let's start by discussing some tools and equipment necessary for modifying (or performing brain surgery on) some of our microwave circuitry. Most of these tools must be small or miniature due to the compactness of most microwave circuitry. A basic bench setup consists of diagonal pliers, long-nosed pliers, and various screwdrivers. The soldering iron should actually be a good soldering *station.* By that I mean a temperature-controlled soldering iron. That's one key pointer for good construction: a low-voltage soldering station.

It pays to search out the nearest "beauty junk box," which is usually found close to the bathroom mirror. What we're searching for are a couple of small pairs of tweezers. I procured mine from the local drugstore in the cosmetics section. The ones from Revlon are the best, but they carry a good price tag. I selected one that had a large, stout hand-hold section and then formed down into a small narrow end section, with a total length of about six inches. They worked out well for selecting components and positioning them on PC boards.

An alternate method is to just dump the component onto the PC board, then try to position it into place with a toothpick, using shuffle-board action. It's not the best but it will work in a pinch. I prefer the tweezers. Part of my trick in using them with very small components lies in the PC board preparation. Here I am talking chip resistors and capacitors and other small surface-mounted parts. Next, I will cover semiconductors and the method used to place them on a PC board.

Positioning Small Components

The real question is: How do you successfully hold a squirming chip resistor or capacitor on a PC board when it's only 0.050" square? Their small size makes them hard to position in place for soldering. Well, that's partly where the tweezers come into play, but the secret is PC board preparation. If the board is home-brewed like the ones you or I make, they need two preparation steps before soldering. This is not 100% necessary but it can make it easier to place chip components on PC boards. Besides, it doesn't hurt to make the project look a little nicer. The first step in board preparation is to apply a thin solder coat on the stripline traces to help in the component soldering operation. This step is performed before any components are mounted on the PC board. A solder-coated PC board is easy to solder and this step also helps to prevent oxidation of the copper surface.

The solder coat operation can be performed with any small soldering iron. The board is first lightly coated with liquid rosin. You can use a small paint brush similar to a watercolor brush to apply the rosin to the copper traces. However, I prefer to wet my finger with rosin and apply it with a rubbing action on the copper traces. A liberal amount will work OK, but a little dab will do just fine.

Once the rosin is applied, use a soldering iron with a small amount of solder and gently rub the solder onto the trace. You will notice that using rosin helps the solder to flow, so you don't need to use as much. As you move the soldering iron, add solder only when necessary to fully coat the trace. In this way the PC board will become fully coated with a very thin layer of solder on the traces and ground surfaces. This will give your PC board resistance to oxidation and help in the soldering of chip components.

I can't stress this enough: *Use solder sparingly.* A very small amount can be spread across the trace with the aid of some excess rosin. Leave the excess rosin on the board at this time as it is somewhat sticky and will hold a part once it's positioned on the board. If you want, recoat the traces on top of the solder with a light coat of rosin to help hold chip components. You will probably have to try several of these methods out and find which ones you like best. It's an individual thing.

Chip components are soldered on the trace at one end of the chip. First, wet the trace with solder in front of the part. Use a small amount of solder, then with a toothpick in the other hand hold the part in place and draw the melted solder pool just in front of one edge of the part up to and over the top of the chip component. Use a sweeping motion over the top of the part. Inspection with a magnifying glass should show a good solder joint looking like a ramp up to the shoulder of the chip component (see Figure 2). If the part moved, re-solder and reposition it before soldering the other end of the component. Once one end of the component looks OK, solder the opposite end of the part to complete installation. Do the same for all components that you need to install, except the diodes and transistors (or FETs). Don't worry about the messy rosin at this time.

When you are ready to mount your diodes and FETs some special precautions are necessary. For most diodes this is not a problem; however, for some signal diodes and expensive Schottky types precautions don't hurt. The diodes and FETs should be handled with proper static precautions, taking care not to destroy these parts before installing them in a circuit. There is no need to fret about static-sensitive components as the precautions for using them are not too demanding. Mounting them with a grounded work station will remove the static voltage.

Removing the Rosin

When the other components are mounted it's time to remove the rosin, which looks quite sloppy on the board. Removing rosin is important because it can have a detrimental effect on the board. It can de-tune the microwave stripline and cause excess loss. It can

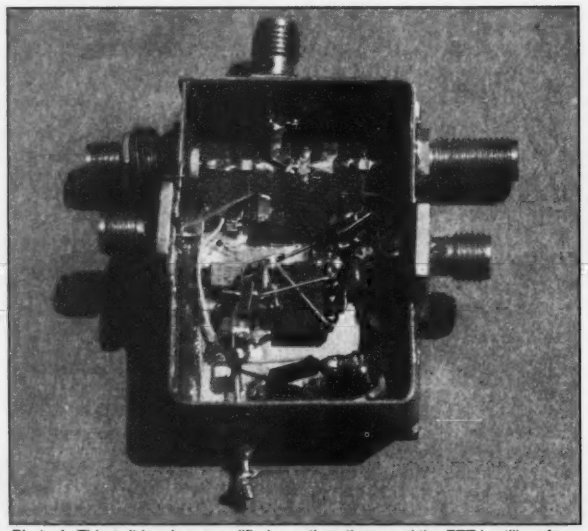

Photo A. This unit has been modified countless times and the FET is still performing well. The circuit is a 10 GHz amp, modified into a 10 GHz mixer. The circuitry at the bottom is a bias supply.

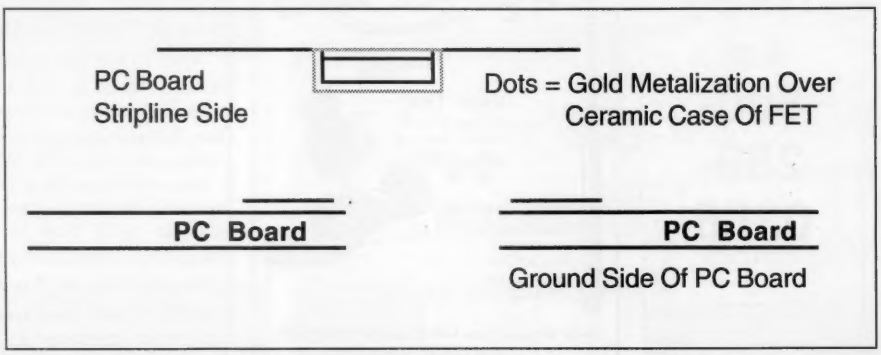

Figure 1. Insert the FET and solder the gold metalization to the bottom of the PC board and to the top source traces. You want to take the shortest possible path to ground to find the lowest possible source lead impedance.

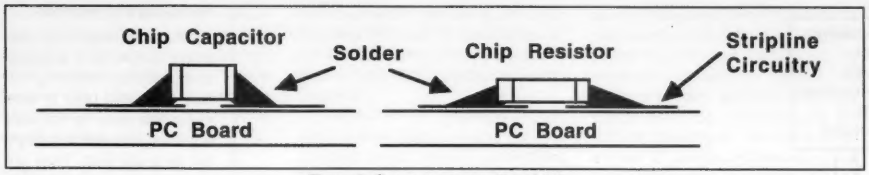

Figure 2. Component mounting detail.

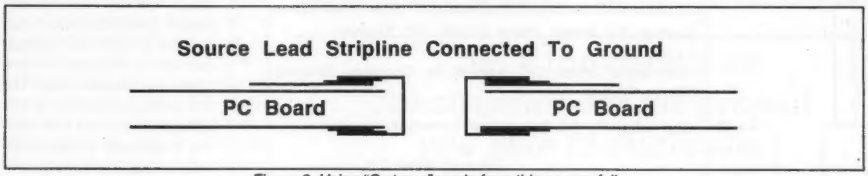

Figure 3. Using "C straps" made from thin copper foil.

also attract the most undesirable material and stick to it, further de-tuning your circuit.

The best method to remove this grungy (rosin) is to use a small plumber's acid brush dipped in alcohol. These brushes are available in most hardware stores for about 20 cents each. Wash the PC board with it. Dip the brush in rubbing alcohol and apply it to the PC board on a slight slope to allow the liquid to run off the bottom of the board. Continue to apply with a rubbing motion with the brush, dipped in alcohol frequently, until all the rosin is removed.

For small PC boards, hold the board above a glass ashtray, using it for a container for the alcohol. Use a small amount of alcohol; a capful or two is sufficient. Alcohol is flammable so keep it away from heat sources. You might need a second rinse to give the board a very clean appearance. Once the board is clean, air dry it or wipe it dry with a rag before mounting the semiconductors and FETs. Always use the grounded static-free work station for this operation.

Other Tools

Now, here are some of other tools to get, besides the tweezers: magnifying glass or eyepiece, some toothpicks, liquid rosin, plumbers' small acid brushes, small diagonal cutters, plus long-nosed or needle-nosed pliers and a good temperature-controlled soldering station. Add to these items a good selection of X-acto handles and blades that will be used in the tuning and cutting of PC board traces to make modifications to the stripline circuitry. These modifications are very necessary to microwave circuitry, and are done with X-acto knives. In this phase of modification you will be cutting traces and trimming them with the knife blades. In microwave work these are our variable inductors and capacitors that are formed by traces on the PC board. When you make cuts, hold the knife firmly and do not push hard on the Teflon PC board—Teflon microwave substrate is very soft and light pressure is all that is necessary. Be sure the DC power is off when doing any trimming on PC boards.

Toothpicks are used to make tuning tools. Glue small bits of copper on the ends of several toothpicks and when they're dry they can be moved about active amplifiers to give you an idea of where to solder permanent copper straps to the stripline. These toothpick tools are quite simple—just don't touch two adjacent leads together because a short is a short is a short, and will most likely smoke a component.

The Static-Free Work Station

At this point, let's describe the static-free work station where we will assemble and mount the static-sensitive components. This can sound quite impressive, but actually it is very simple and easy to construct. The main difference is that all construction is done on a sheet of scrap metal or circuit PC board used for a common ground surface, to which all components and tools are grounded. This removes any static buildup from your work area. No dragging your feet on a carpet before going to work at the station! Sparks are not permitted. If you

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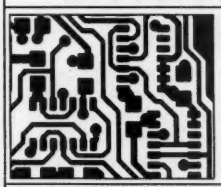

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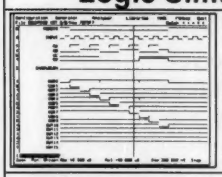

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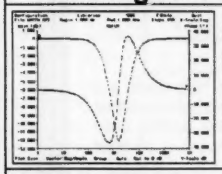

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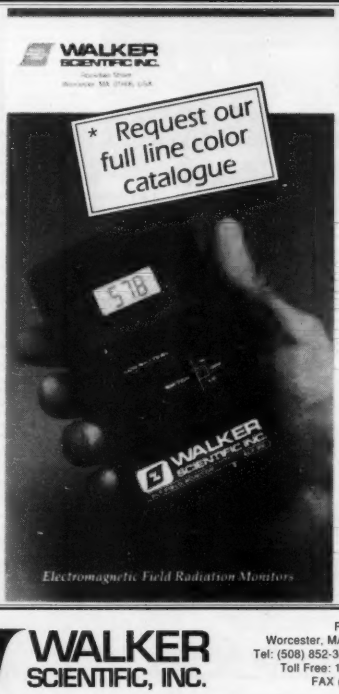
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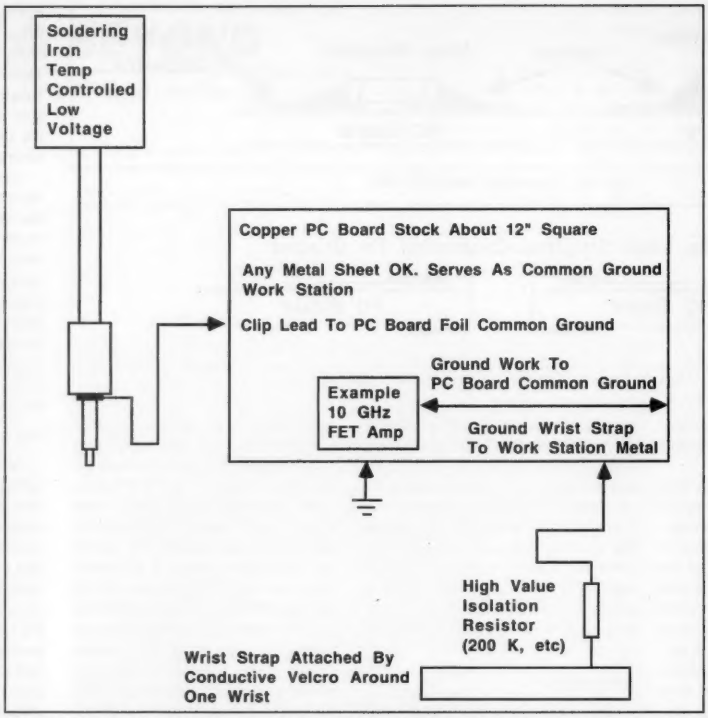
fear the worst, do your construction on a moist day, a minimum static day. Still use the grounded work location.

Your work station pad (a sheet of copper or conductive metal) is where we place the circuit to be worked on (the PC board). Adjacent to the area reside the temperature-controlled soldering iron, tools, *and you!* Be sure to use a resistive conductive wrist strap and not a direct connection to your wrist. Usually these wrist straps have a built-in resistor in the clip lead portion with a resistance of a half megohm or so for a safety factor. The high resistance is so that current that can be dangerous to you will not flow. It will remove static and bleed it off to ground: discharge it. The purpose is to remove static and not carry enough current to light you up.

Don't fall into the trap of "cheating" by touching and holding the grounded work station with your finger while trying to perform the operation. This is not recommended—it is asking for trouble. Use the wrist strap and its protective series resistance. *It is there for your protection.*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Example 10 GHz FET Amp
Ground Work To PC Board Common Ground
Ground Wrist Strap To Work Station Metal
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Wrist Strap Attached By Conductive Velcro Around One Wrist

Figure 4. Construction of grounded work station. Notice that the soldering iron, work piece, and your wrist are all common grounded to prevent static from destroying sensitive FETs.

Soldering Iron Grounds

The only major tool purchase should be a temperature-controlled soldering station. Most used ones or even many new ones do not have a ground connection brought out to a clip lead. They are grounded in some cases; always check. If you do not have a ground clip lead it can be added to the low voltage portion of the iron. These irons are operated from 110 AC and converted to a low voltage in the base unit. Usually it converts to around 24 volts to heat the iron element. To add a ground connection to this type of iron, make a connection from the barrel of the iron at a low temperature point, or better still through the iron's ground lead to the transformer's base. In that case, a connection can be made in the transformer base unit and brought out for connection to the work station.

This clip lead connection is used to remove static from the metal portion of the low voltage iron so as not to harm the semiconductor when you solder it. If you have a high-voltage iron, one that works and heats from

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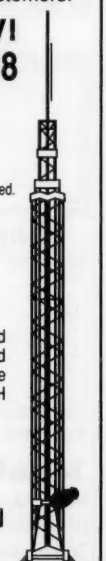

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110 VAC directly, this can be made to work as well. What you have to do is *unplug* the iron just before each soldering operation (with the same type ground clip). Prior to attaching a ground clip on this type of iron verify its AC leakage voltage, a safety factor.

We are doing this to see if the tip is insulated from the heating unit, which is a 110 VAC element. Sometimes the insulation breaks down and allows AC to flow through this defect. It's a safety item and should be checked every so often. Be careful and use insulated test leads for the AC voltage check. I have checked similar irons and good ones will show very low voltage readings, less than a volt or so. However, I have found some that were almost direct connections to 110 VAC due to cracked insulation in older irons. Check to be sure for safety and semiconductor survival.

Mounting Semiconductors

Mounting the semiconductors is very easy. I mount the diodes first. On very small glass-leaded diodes be careful not to bend the leads too close to the package for soldering as the glass can crack on this type of diode during mounting. Just bend the leads into the position you want them and allow a little slack in the leads about the case. Use the tweezers to serve as a heat sink and grounded installation tool when soldering. Prior to mounting FETs, all PC board preparation such as cutting mounting holes or source ground "C" straps should be complete.

Follow the FET mounting instructions. If they state to mount the FET upside-down you need to cut (with the X-acto knife) a 0.1"-square hole to position the FET into. In this case, the ground side of the PC board is soldered to the gold of the FET for minimum source inductance (see Figure 1). If the FET is mounted right-side-up, most likely "C" straps are being used and the circuit allowances were made for some slight inductance. In some cases I have even seen right-mounted FETs; that is, the opposite lead has been trimmed off and the remaining source lead is connected to ground with an additional short section of solid wire. This is a stabilizing technique (degeneration) and is used at frequencies lower than 3 GHz.

"Check the details on construction for the project you plan to duplicate. Use their recommendations."

The "C" straps and minimum source inductance are requirements, particularity at 10 GHz. In 10 GHz amplifiers that we have constructed, the minimum inductance or shortest lead length was found to be the best solution to achieving maximum gain and uniform operation at 10 GHz. Both using the "C" straps and mounting over metal devices upside-down can achieve the same results: stage gain and minimum inductance. Check the details on construction for the project you plan to duplicate. Use their recommendations.

In case of trouble, it helps to have the side of the hole beefed up with a small scrap of copper foil to aid in soldering to the top of the upside-down FET. The thing to be careful about is that the "C" straps do not short out the GATE or DRAIN leads to ground. If this dimension looks close, trim with an X-acto knife for some clearance between leads before mounting the FET. In either case, the hole cut into the PC board will accommodate either the FET or the FET and "C" straps. "C" straps are made from thin copper flashing material and are about 0.050" wide. As shown in Figure 3, they are soldered onto both sides of the PC board. One side is the rear ground foil and the other side is the stripline side source trace for grounding. These straps resemble a "C" when they are formed through a PC board hole.

The last thing to remember is mounting the FETS. They are stored in a static-sensitive protection package and should be picked up only with grounded tweezers. Touch the envelope or box conductive portion (FET storage shipment container) with the grounded tweezers first before touching the FET. This will discharge any differences between the ground surfaces of the work station and the package or envelope. Then, and only then, pick up the FET and place it directly where the device is to be soldered onto the PC board. Once soldered on the PC board the FET is protected by circuit terminations on the board.

Well, that's it for this month. Hope you enjoyed this month's shop talk. As you can see, an elaborate workbench is not required. Happy construction! As always I will be glad to answer questions concerning this and other topics. Please send an SASE for a prompt reply. 73 Chuck WB6IGP. 73

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Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
Route 202 North
Peterborough NH 03458

Let's Mobile

Last month, we were talking about mobile operation. Before we continue, I'd like to pass along a fix for a problem I ran into.

A Detective Story

At a recent hamfest, I picked up a used Kenwood MC-85 desk microphone. It's a nifty microphone which has a condenser mike, built-in compressor and outputs for three separate rigs. I mentioned my purchase to a good friend who used to own one, and he warned me that the mike was very sensitive to RF feedback and, thus, poor for HF. I figured his must have had some kind of problem and proceeded to wire the cable up for my Yaesu FT-747GX.

I keyed up and it worked great! I got several good reports and apparently had no RF feedback problems. I was happy. The next night, I had a sked with my friend, and he reported that I sounded *terrible*, with lots of RF feedback. A quick listen on another receiver confirmed his report: The thing was a disaster. What had happened in the preceding 24 hours?

Ah, Sweet Ground

Usually, when you have an RF feedback problem you have a lousy ground connection somewhere. Finding it isn't always easy, though. In fact, I've had some tough times with these kinds of problems. But not this time. The thing gave itself away when I noticed that grabbing the mike's metal gooseneck, which also encloses the mike element itself, caused extra RF feedback pops and noises. Yet, touching the rest of the metal housing did not have any effect. Now I knew: The gooseneck was not properly grounded to the housing. Upon opening the unit, I discovered that it is built in two pieces. The PC board is mounted and grounded to a metal frame which then screws to the housing. The gooseneck is screwed directly to the housing. So, if the screws holding the frame to the housing are even a little bit loose, the ground between the gooseneck and the PC board gets funny. The cure was easy: I added a ground wire directly from the gooseneck's nut to the PC board's frame. Voilà, no more RF feedback! If you have an MC-85, you might want to add this wire, especially if you have had any feedback problems.

Back To The Car

Out of the shack and back into the car. OK, you've installed your HF rig; you've run your fused, heavy-duty power cable from the battery to the radio; and you've installed and wired your antenna. You turn it on and, hey, it works! Sounds nice and clear, too. But wait, you haven't turned the engine on. Uh oh, now it sounds like garbage. Noise and static out the wazoo. Unfortunately, when you are running a multi-kilovolt ignition system a few feet from a device designed to detect a fraction of a microvolt of RF, you're gonna have some problems. Is it possible to get decent reception in the car?

You Betcha

It'll never be as noise-free as a good, quiet home station, but you *can* get good results in the car. As an example, my Mazda RX-7 used to have an S-7 to S-9 static level, even with the rig's noise blanker on. (It should always be on.) I just assumed that was the best I could do and was resigned to living with it. Consequently, I rarely operated HF in the car. A few months ago, the car started running poorly, so I decided to give it a tuneup. I changed the plugs, wires, rotor and distributor cap. Hey, my noise level went down to S-3! And my car ran great, too. Ignition problems, and especially bad plug wires, can really drive the noise level up.

Other Sources

There are lots of other noise sources in an automobile. Any poorly joined body parts can make electrical noise as they rub with the car's motion. Even wheel bearings can make noise! There are too many potential problems and solutions to cover here, so, if you have a really stubborn static problem, get a book devoted to mobile radio installation.

There are two big noise sources which keep cropping up: fuel injectors and the car's computer. Some makes and models have particular problems which are known to the manufacturers, and a call to the dealer may bring forth an internal memo on the subject. Then again, it may not. Some injectors and computers are just noisy and there's nothing you can do about it. Sometimes, though, the maunfacturers have replacement parts or modifications which greatly reduce the noise. Some will even do it for free.

Warning!

As you can see, it is very common for your radio to be QRMed by your car. But there's something worse: You can QRM your car! Today's cars are electronically sophisticated; virtually all use computers to control the engine. Some also use them to generate the dashboard displays, control the cabin environment and various other things. Some of these computers are quite sensitive to RF, and a few can actually be destroyed by your transmitter, even if it is only a 25 watt VHF rig! If your car misfires or otherwise misbehaves when you key up, you are probably trashing the computer, so you should investigate the problem before you cause some expensive damage.

Honest, Officer, I Didn't Mean It

I remember using my 100 watt HF rig in my old car, which was a 1984 Oldsmobile Cutlass. Once, while tooling around in the Vermont mountains, I was yakking away while rolling along under cruise control. Normally, I watch the speedometer carefully, even when I use the "autopilot." This time, though, I got distracted and never looked down. Suddenly, it seemed like I was going awfully fast. Sure enough, I was doing 85 and still accelerating at the maximum rate. Yikes! I reset the cruise control and everything was fine. And I never got it to do that again. But I have no doubt that my transmitter caused it. Thank goodness I didn't get caught; I would have never explained that one.

There have been many reports circulating on packet radio regarding Toyota Camry computers being destroyed by RF. In fact, several hams wound up with repair bills over $1,000, because the damage wasn't covered under warranty. Apparently, there was an internal memo stating that radios over 10 watts output shouldn't be installed in those vehicles. Last I heard, though, the problem had been fixed. This is only a rumor, however. If you are contemplating getting one of these cars, you might want to check with your dealer before you buy. If you already have one, it would pay to find out if you're courting disaster every time you check into the local repeater.

The Skyhook

Mobile antennas present extra challenges at HF, mostly because of their small size relative to frequency. The standard mid-position loading coil arrangement works fairly well above the 40 meter band, but I haven't had much luck with it on 40 and 75; the efficiency is just too low. But there are other designs which work reasonably well, although nothing is going to work as well as a dipole 50 feet up! The oddest automotive HF antenna I ever saw belonged to a guy I met at a New England hamfest. It's kind of hard to describe this thing: The best I can say is it was horizontal, took up the entire length of his large, American car, and made his vehicle look like something from another planet. He designed it himself, and he claimed it worked like gangbusters on 75 meters.

Although there are several antenna tuners made for HF mobiling, I think it pays to get your antenna as resonant as you can. Efficiency is not that high to begin with, so you're better off if you don't have to use a tuner.

Sometimes, it seems like you have better bandwidth and lower SWR than you expect to get. Before you go rejoicing, take a look at your ground connection between the antenna mount and the car. Usually, a too-good SWR over too wide a bandwidth means you have exceptionally poor efficiency and are losing a lot to resistive loss. Remember, a dummy load always has the best SWR.

Louder?

Can you install a linear amp in your car? You sure can! There are several which have been made over the years, and at least one is still available. Needless to say, you're gonna need some *serious* amperage to run something like that. A big battery and a giant alternator will need to be routed through humongous cables to the amp. And, don't forget that all that RF power will be 2 or 3 feet from your head. Personally, I think I'll pass.

Pounding Brass

Can you pound brass in your car? Sure! I've tried it a few times, using the Microkeyer iambic keyer project I published some time ago. It works and it's fun, but you need to be a decent CW op to avoid getting so distracted that you impair your driving. Obviously, you can't be writing anything down while you drive, so you need to copy in your head. RF feedback into the keyer or hand key can be a problem which results in RF burns on your fingers. Be sure to use shielded cable from the key or keyer to the rig.

Well, that about covers it for mobile operation. There's a special thrill you get from talking around the world, or around town, while you cover the distance between home and work, or wherever. Happy and *safe* mobiling. Now, let's look at a letter:

Dear Kaboom,

I'm considering upgrading my station and I'm very interested in DSP (digital signal processing). Several new rigs offer inboard IF-level DSP units, and there also are several third-party outboard AF-level DSP units available. Which is better?

Signed,
Dr. Digit

Dear Dr.,

In theory, IF-level signal processing should always be better than AF-level processing, because you deal with the signal before the AGC stages. That way, if you remove an offending signal, it won't cause unwanted AGC action. With AF-level processing, you have no control over that, and strong interfering signals near the one you want to copy can still cause trouble, even though the filter has taken them out, because they cause the AGC to clamp down.

As practiced today, though, it's a different story. The functions available on the inboard units just don't compare to the neat stuff you can buy in the outboard, AF-level boxes. So, for now, I'd recommend you go with the outboard approach. Perhaps in a few years the rig makers will put some serious effort into DSP and catch up with the specialty makers. By the way, I covered this subject in some detail in the July and August 1993 issues of *Radio Fun*. You might want to check those out. Enjoy your new gear! 73 and see you all next month, de KB1UM. 73

HAM HELP

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I need operation and service manuals for COLLINS Model 32MS-1C tube-type transceiver, Serial #287. I will pay copying and mailing expenses; or furnish me the latest mailing address of Collins Radio, Canada or USA. Thanks to all who respond. *Benmamin Tan, United Marketing, Isabela, Basilan Province, 7300 Philippines.*

I am looking for mods for the HTX-202 2m HT. If anyone has any, please send to *Trevor Davis VE3DKV, 107 Government Road East, Kirkland Lake, Ontario, Canada P2N 1A9.*

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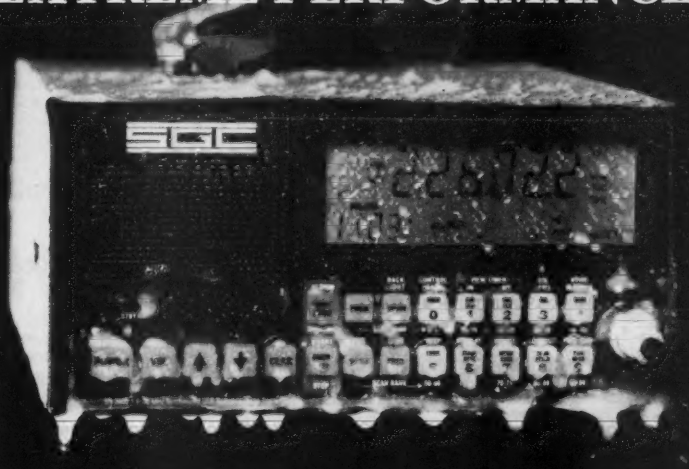

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SGC

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NEVER SAY DIE

Continued from page 4

The main problem is that we're not interesting our newcomers enough to hold them. They go to a club meeting or two, find they are treated like lepers, and give up. Ten meters is nearly dead and will be for a few years. And CW at 5 wpm isn't nearly as much fun as you've told them it is. The result is that 94% of the Novices aren't seriously active. They spend less than an hour a week. That rattle you hear is amateur radio's death rattle unless you can figure some way to make hamming more fun. Fast. We're dying.

Oh well, Novices are kids anyway, right? Well, not exactly. Their average age is 39. Heck, when I got started in amateur radio the average age for all hams was about 32. Now the Techs average 45 and it's 50 for all hams, which puts the Advanced and Extras up in the 60s. No wonder almost everyone I work on 20m is retired.

Has your club made any effort to get newcomers to your meetings and get them involved with club activities? The answer, with very few exceptions, is no. Two-thirds of the Novices have never been to a club meeting. Most of the rest tried one or two and gave up in disgust. Very few said they were involved with any club activities.

What ever happened to the old ham radio fraternity concept? I read many of the club newsletters and I see very little evidence of efforts to involve newcomers. We've let the hobby turn sour on our watch. We're putting up with bad language on our bands. Our personal ethics are a mess. We've cut off our newcomers. We used to be very proud of being hams. And rightly. We were the pioneers of all new radio modes. We were the major supplier of the best engineers and technicians to industry. And when WWII came along we helped save the country's bacon by volunteering for military duty. Eighty percent of us joined the armed forces. And don't you forget that it was electronics that was our big edge. It was a technology war and we hams were right there in the thick of it.

We've let ourselves become virtually useless. In 1964 we killed off thousands of school radio clubs. These were the clubs that fed us young newcomers and we've never had any significant growth since. Nor, lacking the enthusiasm and drive of youngsters, have we been able to keep up with commercial technology, much less be in the forefront.

If you were running a business and you found that you were getting fewer and fewer customers, would you consider making some changes? Worse, most of the new customers you get to come in the door go right back out and don't come back. Are you doing something wrong? Has your product or service kept up with the world as it is today?

In business you either grow or die. So what's holding back our growth? I've been talking about that in my editorials, so my ideas on the subject won't be any news flash for you. But let's not just accept my ideas. And let's not stick by the ARRL's either. Let's survey the kids and find out why they're not interested in amateur radio any more. Yes, I know all the old excuses. TV, video games, on-line computer services and such keep kids too busy for them to take the time to learn the code and memorize the patheticaly simple tests we've got set up as obstacles to keep out the "wrong" people.

Well, I've seen no sign that we've had any success in barring the wrong people. We've done a really fabulous job of keeping a lot of "right" people out.

The League hasn't a clue as to what to do to turn things around. They're asking, "What, if anything, can be done to reverse the trend?" Am I exaggerating? Check out page 9, July 1993, *QST*, last paragraph.

Wayne's Prescription

I'd like to see amateur radio fulfill its real potential . . . to help kids, our country and the world. I'd like to see millions of kids getting on the air and filling up our incredibly valuable, but presently vacant, microwave and satellite bands. I'd like to see 'em experimenting, building kits, and pioneering new technologies. We have no shortage of new modes for them to develop.

One thing we do know from experience is that everything our government does it messes up, and the management of amateur radio is no exception. I wish the socialists and liberal left would go live awhile in the remaining socialist countries, China and Cuba, and get over their delusions. Maybe they'd stop trying to get the government to do everything for us.

My dream is to have amateur radio run by our radio clubs instead of the government. The clubs would be responsible for recruiting newcomers . . . kids in particular. They'd Elmer radio clubs in schools. The clubs would teach theory and operating practices and then would license the members who earn the priviledge. The clubs would be responsible for their licensees and for the de-licensing of any member abusing our priviledges.

I envision a national conference every other year where delegates from each of the clubs would discuss and vote on any rule changes proposed by the clubs. I'm sure you can come up with a long list of reasons why this wouldn't work. But I warn you, though I haven't taken 10 pages here to try and refute your objections, I doubt that you'll be able to come up with one for which I haven't a good answer. I've given this a lot of thought.

Indeed, a few years ago I made the

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rounds of the FCC Commissioners and asked them how they liked the idea. The all agreed it would be a great system. They also agreed that the FCC would be glad to provide whatever legal expertise might be needed in the framing of new rules. The FCC would love to get out from under the expense and aggravation of handling our rule making and licensing. The Commissioners know little about amateur radio and, for the most part, would prefer to keep it that way. Well, if the White House ever gets around to appointing some new Commissioners we'll have a fresh opportunity to rewrite our ticket.

I've pointed out in my recent editorials that unless we do come up with some major changes in our hobby, we're sitting ducks for any well-funded lobbying effort to knock off. Our bands are essentially up for grabs unless we re-invent a relevant need for them. I recommend this be centered around our 21st century need for one hell of a sharp bunch of engineers, technicians and scientists. Without 'em our American standard of living is going to keep on dropping, and so will the dollar.

Technology developments in communications, computers and transportation have narrowed the oceans which isolated us from Europe and Asia. We're now in competition with the whole world and we'd better understand this and stop trying to erect trade barriers to protect our underskilled, undereducated workers.

The most successful countries are going to be those making high-tech products. The big money is in manufacturing, not flipping hamburgers or sorting mail by hand. So we've got to re-invent our whole lousy school system so we can create a flood of youngsters who are excited about technology and looking for high-tech careers. Super Mario Brothers isn't going to do it. Even CompuServe isn't going to do it. The only hobby we have with the potential to fire the enthusiasm of millions of kids to learn about electronics is amateur radio.

We can get 'em on the air. We can set up our ham satellites so they can talk anywhere in the world 24 hours a day. We can get 'em excited about fox hunting, QRP, packet, SSTV, and so on. Maybe we can get back to where we were in the 1950s when 80% of all newcomers to amateur radio were youngsters, and where 80% of them went on to high-tech careers as a result. If America doesn't manufacture the electronic equipment for our businesses and homes, you can be sure someone else will, and where these factories go, so will go the biggest banks, and the highest quality of life.

Can the FBI Help?

Voice-operated transmit (VOX) seemed like a great idea when it was invented, but it never got off the ground. You know why? Several reasons. The clanking of the antenna relay was one big problem. The slow recovery time of most receivers was another. But the worst was that if there was any interference the other station was never sure just when you were listening. So what happened when ops used their VOX was they'd keep right on talking to keep that relay from clacking. In between sentences they'd "aaaah" it to hold the rig on the air.

Modern technology has done away with most of the relay noise and has improved our receiver's ability to be turned on and off quickly. That leaves us with only one minor problem: letting the other person know when we've stopped transmitting.

The best way to generate normal conversations instead of our one-way broadcasts to each other is to separate our transmitters and receivers by a few miles so we can listen while we're talking . . . as I suggested recently. But if this is beyond your ability to handle, the next best approach is fast break-in (FBI). Now, in order to let the other person know when you've stopped transmitting I suggest you add a little beep, like the ones we use on our repeaters.

Let's see what you can do about building a circuit which will automatically beep or chirp when you stand by. If this catches on we'll soon see it being built into the new rigs. In the meanwhile, look for some kits. Yes, I know, there are a few DX chaps already using this approach. Good. What I want is to help make it so we can have the most natural conversations possible. This will make hamming more fun and help attract more newcomers to the hobby. I've gotten several letters recently from non-hams saying they lost interest in getting a license after hearing how boring so many of our contacts are. I know I'd be a lot more active if more contacts were interesting.

Get busy and design a circuit, check it out, and send me an article so we can get a few hundred hams to build it.

Once we're using fast break-in we'll have to break the ID habit. Every 10 minutes is fine. And it isn't necessary to repeat my call all the time. I already know it just fine.

I'm hoping that between duplex and fast break-in we'll be able to start talking more naturally and as a result our contacts will start being more interesting. I'd still like to see some way to have you send a list of things you're interested in so I'd know what to ask you. I'll bet you've done some fascinating things I'd like to hear about. Maybe you've been some places I'd like to visit. Maybe we have some other hobbies in common. We could have a great time and really be looking for each other for more contacts.

But a stereotyped QSO bores me silly. I guess it wasn't so bad for the first 25 years or so, but it's gotten old.

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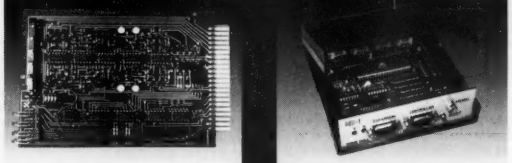

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A Quote from *Forbes*

A recent *Forbes* column by Peter Huber discussed the effect technology is having on us. For instance, when I was young we spent a lot of time on penmanship. Well, handwriting was how one communicated then. Typewriters were too expensive for the home and typing wasn't taught in school. Once typewriters were cheaper, the need for good penmanship disappeared.

Spelling was a big deal when I went to school. Now it's handled by my word processor, which catches my errors. Peter suggested that before long making kids memorize all the irregular spelling rules will be like making radio engineers learn the Morse code. Heh.

We'll soon have automatic language translation, and computers with voice input. Look where we are with bar-code and checkout counters which add up the items, calculate the change, debit the store inventory, and presumably even add in a few cents here and there to pad your bill. Fast-food cash registers have pictures instead of numbers, which is handy since fewer and fewer kids are being taught how to make change.

If you're into video you can have a complete video production lab at home and do what used to take millions of dollars in equipment all by yourself. In audio, DAT recorders are under $1,000 and outperform a whole studio full of gear from a few years ago. Gas stations let you pump your own and pay with a credit card, with no attendant needed. Well, we're a little behind on that one. I remember HB9RF doing that in Zurich over 20 years ago as we were driving to visit his moonbounce station.

"Are you keeping up with technology? As a ham you're expected by the public to be knowledgeable about high-tech."

Are you still writing by hand? You're two generations behind. I changed to typewriters as soon as I could, carrying portables with me on my trips. Then I changed to word processors, moving to a laptop system around 1980, as soon as the first one was available. I moved from CW to voice in 1939 . . . and from voice to RTTY in 1949. I put up my first repeater in 1969. Our pioneering HTs and repeaters of 1970 are now worldwide as cellular telephone systems.

And look what's happened to those microcomputer kits we were playing with in 1975! Now we're using them to replace million-dollar typesetting systems. One of the first ads for the MITS Altair 8800 computer appeared in *73*.

Are you keeping up with technology? As a ham you're expected by the public to be knowledgeable about high-tech. Can you see where technology is taking us? All you have to do to get ahead of the game is know something like that before others do. Joe Sugarman W9IQO figured out that there would a market for electronic gadgets, so he started selling them by mail as JS&A and made millions. Steve Jobs figured there was a market for a single-board microcomputer, and didn't do badly. Bill Gates figured these new micros would need operating systems and parlayed that idea into a few bil.

If you really want to feel bad you can dig out some old issues of *73* and read where I told anyone paying attention about these opportunities at the time, including the one Bill Gates exploited. There are just as many opportunities today, if you think in those terms. Steve Jobs started out with nothing but a prototype built by Steve Wozniak. Bill dropped out of Harvard to work for MITS, in Albuquerque, where the action was.

Communications, computers, information systems . . . all are changing. We're ready for a major change in education which will generate a few more billionaires. Ditto health care, which is a trillion dollar industry, and growing fast. How close are you to the change? Close enough to see the opportunities and benefit?

Every major misery we have in America offers opportunities for the person willing to pioneer and work. The downside is that if you're money-driven, your chances of making it big are not good. You'll do best if you see something that needs to be done, figure out how to do it, and then work hard. Bill Gates made his billions accidentally. He's still wrapped up in what he's doing, not in making money.

In my reports to the New Hampshire Economic Development Commission I've been coming up with endless ideas for new businesses and new areas that need to be researched and pioneered. My first reports have been reprinted in my *Declare War* book. Those since then are in my *Declare War Update* reports. They're available via Uncle Wayne's Bookshelf.

One of my joys is in getting letters from hams thanking me for keeping at them through my editorials to get out there and be an entrepreneur. Some have been very successful, and all of them know a freedom they never experienced before. 73

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Notes from FN42

As this month's column is being written, we in the U.S.A. are watching Hurricane Emily churn toward the central East Coast, hoping the storm will not strengthen and cause damage to life and property. So far, we have been very lucky in that no loss of life has been suffered, even though the storm grazed the outer banks of North Carolina. Meanwhile, Typhoon Yancey was headed toward Okinawa and Japan, lashing out with high winds and heavy rain. I certainly hope that David Cowhig, Hambassador to Okinawa, and the rest of the people will be safe and secure.

I made it back to Colorado this summer, but wasn't able to have an eyeball with any of the Gunnison hams. I did find out that the triband beam received from Fran, the widow of Fred Palmblad WØCYM, was used during the Field Day operation, and that a plaque has been permanently placed on the beam by the Gunnison Valley ARC. Fran's generosity has certainly started me thinking about what amateur-related equipment I might leave to local hams or the local ham club to help further this fantastic hobby. I have already compiled a list and am planning to include it in the next update of my Last Will and Testament. I think that this is really a way that we can all get involved, but in a slightly different way. Think about it! Lastly, I am very happy to introduce a new Hambassador from the Philippines, Lorenzo D. Gaston DU1CHD/6. He sent along three submissions for our pleasure. Welcome, Lorenzo! That's all for this month. On to the great news from around the world! 73, Arnie N1BAC.

Roundup

Dominican Republic *Letter from Bill Meara N2CQR/HI8:* Greetings from Santo Domingo, capital of the Dominican Republic ("The DR" for short), land of sunshine, merengue music, and FB ham radio! The members Radio Club Dominicano have authorized me to serve as "*73* International's" Dominican Republic Correspondent. I am on assignment with the U.S. Embassy here; my selection as correspondent was based largely on my more than 30 years of practice with the English language! We've seen the excellent reports from around the world and wanted to send in a contribution from the DR.

The Dominican Republic is located on the eastern two-thirds of the island of Hispaniola. We are on the large island between Cuba and Puerto Rico. The country has a population of over seven million and is Spanish-speaking. French-speaking Haiti occupies the western third of the island.

Ham radio is big in the DR! A drive through Santo Domingo reveals numerous HF yagis. Radio Club Dominicano (HI8RCD) is the IARU affiliate and has been in operation since 1926. The club sports a complete HF station, along with 2 meter gear and packet equipment. A second club, Union Dominicano de Radio Aficionados, is also very active in Santo Domingo. In the country's second city (Santiago) there is much club activity, including the Hotel India DX Association.

Dominican hams are involved in a wide variety of radio operations. HF SSB DXing is the most popular. Geography has blessed the island with good DX conditions (we are surrounded by salt water and have abundant solar radiation!). There are approximately one million Dominicans living in the U.S. (mostly in the New York area), and amateurs among this expatriate population maintain schedules with ham friends on the home island. There is a lot of 2 meter FM activity, and the packet revolution has also swept through HI land. There is a small group of 6 meter enthusiasts providing a new country for VHF buffs. Hams here have worked the *Mir* space station, and there is interest in the satellite program.

The numbers after the HI prefix indicate geographic region (8 for the capital, 3 for Santiago, etc.). The suffix letters are usually based on the ham's initials. Old-timers are authorized single-letter suffixes. Foreigners operating with Dominican licenses have suffixes that begin with X. The DR has a reciprocal license agreement with the U.S.; hams operating under this agreement work with their home call, followed by /HI. ARRL headquarters has up-to-date information on the fairly simple process for obtaining reciprocal operating permission.

While not really in the category of rare DX, an HI call can stir up some pile-ups on the HF bands—lots of fun for a visiting U.S. ham.

Tourism is one of the country's largest industries, and we are sure that there are hams among the million or so sun-seekers who visit the DR's beautiful beaches every year. While most of the resort areas are quite distant from Santo Domingo, tourists do frequently make it to the capital. If you're coming to Santo Domingo, drop us a line, and we'll see if a visit to the club can be arranged.

Dominican hams are very friendly to hams from across the sea. HI8RCD currently has members from the U.S. and Japan. Over the years, foreigners on assignment in the DR have been very active in the local club.

We will try to provide "*73* International" with periodic updates. For now, best of 73 from HI8!

[Bill Meara N2CQR/HI8, Unit 5510, APO AA 34041 USA]

Russia *From Yuri V. Funkner, UN9LX (ex-UL7LS):* The International Diploma Foundation is a nonprofit, volunteer effort devoted to the development of world amateur radio by means of establishment of various awards. Membership is open to anyone who shares the objectives of the foundation and is ready to pay the entrance fee. Donors will receive handsome certificates. All gifts will be acknowledged. For further information, write to: Yuri V. Funkner UN9LX, IDF Secretary, PO Box 1 Frunze 459411, Ordzhonikidzevskiy Rayon, Kustanayskaya Oblast, Republic of Kazakhstan. *[Yuri also hosts a DX Net on 7043 KHz on Friday at 1900 UTC.]*

Switzerland *From the International Telecommunication Union (ITU) Press:* The ITU has created a new strategic consultative body to step up telecommunications development worldwide. The Telecommunication Development Advisory Board (TDAB) held its first meeting on 6 and 7 July 1993 to advise ITU on priorities and strategies for telecommunication development, to advise ITU member countries on how best to step up telecommunications development and to reinforce the role of the development machinery of the Union in this area.

The board will neither exercise supervisory functions nor will it be involved in the management of ITU's development sector. It will, however, be required to:

•Provide views and recommendations that will contribute towards the development, expansion and efficient operation of telecommunications;

•Help in raising the level of awareness of decision-makers of the importance of telecommunications in socio-economic development of nations;

•Encourage the participation of industry, telecommunication operators and service providers, bilateral and multilateral organizations and financing institutions to promote telecommunications development in developing countries;

•Assist in the mobilization of actions and resources for pre-investment and investment activities in the field of telecommunications;

•Assist in the preparation of telecommunication development conferences.

U.S.A. *From Patrick G. Lehrman N9JPV:* The June issue of *Radio Fun* ran an article about the "School-to-School QSO Contest." Many schools, hams, and clubs in the U.S. and Canada have responded to that article. The contest started at 1200 UTC on October 5 and ran through 1200 UTC on October 6, 1993.

Please send photocopies of logs as well as any interesting stories to the Westmont Amateur Radio Club by December 31, 1993, at 125 S. Grant St., Westmont IL 60559-1907 U.S.A. *[This letter described the contest but arrived too late to be included in the October issue before the contest.—Arnie]*

CANARY ISLANDS

SPAIN

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Well, the Amateur Radio Congress, held in Las Palmas last fall, came out great. We had hoped for more foreign participation, but about the only foreigners who showed up were the vice president of the French amateur radio organization and his wife, a Portuguese couple, and some Russians who had sailed here in a Viking-type ship (that would be worth a story in itself) some months earlier. There was a wide range of activities, excursions, and such which they pulled off with the usual flair. This was another event in which a good time was had by all. More recently, they hosted a CW contest weekend. I'll have to get up that hill again to see what they're planning next.

In a previous report, I mentioned learning to make Canary knives so I could know what I was talking about when I wrote about them. I suppose that is a worthy motive, but it certainly doesn't guarantee that if someone has experience, that they can then write clearly and correctly about a particular subject.

*In a different report, I mentioned something about heroes in the modern mold. What I had in mind was heroes of moral courage instead of, say, physical courage. People who can inspire us by the moral nobility they display under extraordinarily difficult circumstances. Isn't this what the world needs today? Certainly not more efficient soldiers, as noble as that is under certain circumstances. What I am thinking of is people like Matthew Henson, who accompanied Peary in his achievements in the Arctic. Well, maybe more than accompanied. Peary referred to him as "indispensable, more of an Eskimo than some of them," and he is still greatly admired by the descendants of the Eskimos among whom he moved. "Kind Matthew" he was known among them, and my favorite photograph is of him holding a muskox calf in his arms (*National Geographic *Vol. 174 No. 3 September 1988, p. 422).*

He became one of the greatest hunters and sled drivers of all—instead of living out his life as the sharecropper's son he was. There is no doubt that he had tremendous physical courage, but he also had much more. Loyalty, humility—you might enjoy reading his story.

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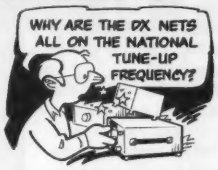

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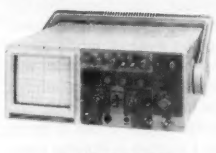

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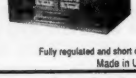

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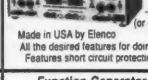

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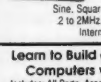

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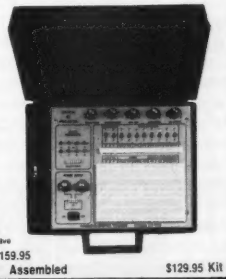

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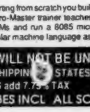

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Also included is a new chapter showing how you can use transistors to replace hard-to-find vacuum tubes. You'll even see the circuit that was lashed together on a table top one night using junk box parts, a hair curler and alligator clips. Attached to an antenna strung across the basement ceiling and a 9 volt battery, signals started **POPPING** in like crazy. In a couple of minutes an urgent message from a ship's captain off Seattle over 1500 miles away was heard asking for a navigator to help him through shallow water!

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opening address was given by pioneer packeteer Bentzi 4X1IL, while the Hannukah candles were lit by Yankele 4X1AH, IARC President. Further talks on subjects related to packet radio were made by Yossi 4X6KJ, IARC Chairman, Naftaly 4Z4RM, and "Dimona Danny" 4Z9DDA.

The Packet Cluster, which shall soon start operation on 144.675, the 4XNet frequency, was discussed by 4X1IL, 4X1GP, and 4X1DA. The first Cluster's callsign will be 4X4BX, in memorial to the late DXer Sioma Manzari 4X4BX, who was the first IARC chairman. Hot DX information will be transmitted to all Cluster members who have left their packet gear on the frequency in the same manner as in a telephone conference call.

Jim 4X1RU outlined the newest version, 5.14, of the F6FBB BBS program, which is installed in his BBS and requires one megabyte of computer memory. Mail from abroad comes through 4X1AS's satellite gateway and six European HF BBSs. Features of the new software are: a BBS data base which completes incomplete addresses automatically, a REJECT file to zap undesirables, and an SR (Send Reply) feature that automatically addresses according to the number of the message being answered. Jim also reviewed the amateur communications software being integrated into the Technion's satellite project, the Techsat.

Peleg 4X1GP clarified points on proper packet operation stressing the inclusion of one's own packet forwarding address in the body of the message, so that the addressee will know how to reply. Recommended operating parameters for the TNC dealing with switching time and delays for proper integration into the Net were discussed.

He also explained the TCP/IP protocol and the latest improvements made in it. He recalled the problem of the "hidden station" that reduces the through-put in the system to 18% of the capacity. He presented a solution where a commanding station will work as a digital regenerator transmitting what it's receiving simultaneously. This will raise the efficiency to 56% at the cost of allocating two frequencies to communication.

Shlomo 4X1AS described the communications programs (PG and PB) for working on the satellites OSCAR 16 (1200 baud) and OSCAR 22 (9600 baud). Messages are sent in the BROADCAST mode, and the satellite can be utilized by up to 20 users simultaneously. If 20 are already connected, you are given a number and must wait in line until your turn comes up. The satellite transmits 10 seconds to each connectee. Material stays in the satellite from two to four days and the local directory should be constantly updated. If the requested information is not received in the present pass, the program will automatically request it again when the bird comes overhead the next time. Files arrive in compressed form and as such are transferred to 4X1RU, where they are unraveled. There are 25 satellite gateways in the world. Each one receives material only from other gateways and checks the satellite's directory if there are any messages for it.

All-in-all, this year's Packeteers' meeting was a fruitful one, giving a good forum for the exchange of ideas and furthering the advancement of the fast-growing field of digital communications in Israel. Looking back to the inception of packet in Israel a mere six years or so ago, the growth has been amazing. *[Also amazing in the rest of the world too!—Arnie]*

OKINAWA
JAPAN

David Cowhig 7J6CBQ/WA1LBP
AmCon Naha
FBU PSC 556, Box 840
FPO AP 96372-0840

Now it is late June. The plum rain season has ended and we are moving into Okinawa's hot season. Soon will come the Eisa festivals throughout Okinawa (July and August) where the Okinawans, who follow the ancestor-veneration religion of the Chinese, welcome back the spirits of their ancestors for a three-day visit. Large groups of men and women dance in fine costumes, some carrying drums like those shown in JS6ANO Hokama-san's QSL card. The instruments and distinctive rhythms of Okinawan music, very different from those of the rest of Japan, owe much to Indonesia, Thailand, China and probably India as well.

When Emperor Akihito and Empress Michiko visited Okinawa in April they passed just 200 meters from our house in the central Okinawan village of Kitanakagusuku on their way to visit some handicapped children. Our neighbors waved Japanese flags as the couple drove by in their black limousine and helicopters circled overhead. Not to be left out, my children, Patrick and Frances KD4BMJ, grabbed Japanese flags and waved them enthusiastically as the Emperor and Empress passed by. I couldn't help but think what a wonderful difference 50 years makes!

One theme of the Emperor's visit for the National Arbor Day Celebration was reconciliation with the Okinawan people who had suffered terribly at the hands of the Japanese Imperial Army. Today, as they do every June 23, Okinawans remember the 200,000 Japanese, Americans, and Koreans who died here in 1945. The Okinawans plan to dedicate a memorial on the 50th anniversary of the Battle of Okinawa, which will have the names of all the soldiers—Japanese and American—who died in the battle. In the words of Jana, the 17th century Ryukyu Kingdom statesman, "inochi da takara"—"life is treasure."

During a mid-May trip to Yonaguni, the westernmost of the Japanese islands and home of the world's largest moth (wingspan up to 24 cm!), my efforts to reach Taiwan, just 80 miles, on 2 meters failed but I met island physician Masaki Akamine JS6GNM, his wife Mimako JS6KHO and their two children. The Okinawa Prefectural government assigns Akamine-san to a new outlying island every two years. He likes islands so he started his assignment on Yonaguni, population 1800, in May 1993. I met JS6GNM on the 80-miles-distant 439.88 MHz JR6YI Ishigaki island repeater but soon switched to 2 meters simplex and then the eyeball mode since Akamine-san's home (and clinic) was just 50 meters from my minshuku (Japanese traditional-style hotel). The Akamines took me on a tour of the island while I worked in Honshu using his 3 watt Mizuno 21 MHz SSB handie talkie. We finished the evening in a restaurant run by Yonaguni Mayor Tsuimaji's family—named the White House, naruhodo (that's, of course, in Japanese).

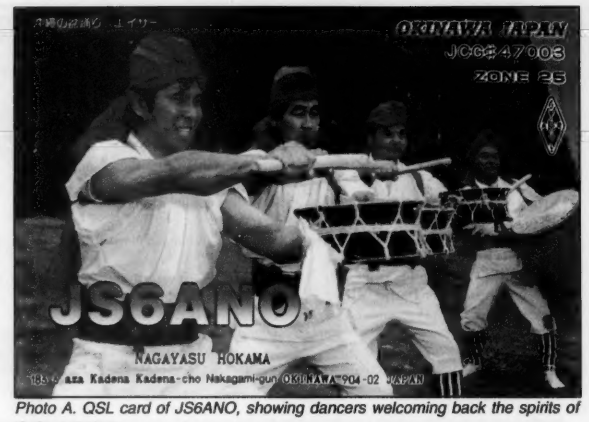

Photo A. QSL card of JS6ANO, showing dancers welcoming back the spirits of their ancestors.

Yonaguni lives by raising beef cattle, growing sugar cane and vegetables, fishing, selling the local awamori rice liquor (at 60% alcohol the strongest brew in all Japan), and tourism. Yonaguni enjoyed a brief boomtown era (the island population hit 12,000 in 1947) as Japan's Wild West just after World War II. Enterprising smugglers liberated goods from the US military PX for cheap Taiwan rice which they could sell for a 700% profit on the Japanese black market. *[More next month!—Arnie]*

PHILIPPINES

Lorenzo D. Gaston DU1CHD/6
PO Box 27
6116 Silay City, Neg. Occ.
Philippines

Amateur Radio licenses in the Philippines are issued by the National Telecommunications Commission (NTC). NTC is under the Department of Transportation and Communications (DOTC). NTC is headed by one commissioner and assisted by three deputy commissioners. The NTC issues Amateur Radio Licenses and Radio Amateur Operator's Certificates with a maximum effectivity period of three years.

There are four classes of amateur radio licenses in the Philippines: Class A, B, C, and D.

Class A licensees have full privileges and their authorized station power output is limited to 2 kW PEP SSB or 1 kW CW. Class A licensees who have operated for at least five years as Class A are qualified to be either appointed as club station Trustees or deputized by the NTC as Amateur Radio Inspectors or both. Class A licensees are assigned DU prefixes, but they are also given only one option to change the callsign prefix from DU to either 4D, 4E, or 4F. All club stations are required to have a (qualified) Trustee. Licenses to operate repeaters are only granted to duly recognized amateur associations, clubs, or societies. All club stations and their repeater(s) have the same callsign and are assigned DX prefixes.

Class B licensees are not authorized to transmit on the 160 meter band. Operation on 20 meters is allowed except on the segment from 14.100 to 14.275 MHz. Operation on all other bands and modes are allowed and authorized station power output is limited to 1 kW PEP SSB or 500 watts CW. All Class B licensees are assigned DU prefixes.

Class C licensees are authorized to transmit on all modes on 40, 15, 10, and 2 meters only. Authorized station power output is limited to 200 watts PEP SSB, 100 watts CW, and 100 watts on 2 meters. All Class C licensees are assigned DU prefixes.

Class D licensees are limited to 2 meters only (all modes) and 100 watts power output. All Class D licensees are assigned DY prefixes (DY-prefix QSL cards are not valid for the UN-DU Award or any other award so please do not contact or send a QSL card to a DY-prefix station on any band except 2 meters, just in case you hear one.

A "Radio Amateur Operator Certificate" is a certificate of authority issued by the NTC to a qualified person who has passed an appropriate amateur radio examination. This certificate authorizes the holder to operate any licensed amateur radio station of an appropriate class as indicated in the certificate.

Next month I will cover the reciprocal licensing in the Philippines. 73!

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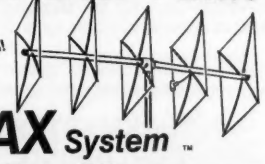

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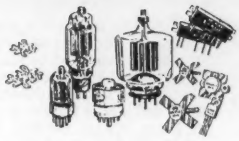

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SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event. Check ***Special Events File Area #11*** *on our* ***BBS (603-924-9343)****, for listings that were too late to get into publication.*

NOV 7

KAUKAUNA, WI The Fox Cities ARA will hold a Ham and Computer Fest at the Starlite Club. VE Exams. Talk-in on 146.76 (CTCSS 107.2 Hz). For details, contact *Dan Vanevenhoven N9LVS, 2410 E. Newberry, Appleton WI 54915. Tel. (414) 739-5101.* VE Exams, contact *Larry Siebers KD9IA, (414) 788-3823.*

NOV 13

MONTGOMERY, AL The Montgomery ARC will host the 16th annual Montgomery Hamfest/Computer Show in Garrett Coliseum at the South Alabama State Fair grounds on Federal Dr., from 8 AM-3 PM CST. VE Exams start at 8 AM. Talk-in on 146.24/84 (W4AP). Ragchew on 146.32/.92 (with phone patch, "up/#down), 147.78/.18, 449.50/444.50. Special Rates: *Days Inn, (205) 269-9611; Coliseum Motel, (205) 265-0586 or (800) 876-6835*; or *Best Western Regency Inn, (205) 260-0444/(800) 528-1234.* Contact *Hamfest Committee, c/o 111 Diane Dr., Prattville AL 36066*, or phone *Jiggs, (205) 365-0380. FAX (205) 264-1150.*

PLYMOUTH, MA The Mayflower ARC will host a Flea Market at the Plymouth Memorial Hall Bldg. in Plymouth Center (RT3A), from 9 AM-3 PM. Walk-in VE Exams. Talk-in on 446.625- and 146.55 simplex. For Flea Market info, call *Jon WS1K, (508) 746-0162* or *Jim NM1F, (508) 747-2224 eves.* For exam info, call *Bob, (508) 747-6022.*

NOV 13-14

FORT WAYNE, IN The Fort Wayne Hamfest/Computer Expo and 1993 Indiana ARRL State Convention will be hosted by the Allen County AR Tech. Soc., Inc., at the Allen County Memorial Coliseum Expo. Times: Sat. 9 AM-4 PM; Sun. 9 AM-3 PM. VE Exams, Forums, Meetings. Talk-in on 146.88-. For table info call *(219)-483-6305.* For details, call *(219) 484-3317.*

NOV 14

BRANFORD, CT The Southcentral Conn. ARA will hold its 14th annual Flea Market at the Branford Intermediate School, 185 Damascus Rd., starting at 9 AM. VE Exams—reservations must be mailed to be received before Nov. 1st. Talk-in on 146.01/.61. For details, call *Brad, (203) 265-9983, 24 hrs.* Mail reservations with SASE to *SCARA, P.O. Box 705, Branford CT 06405-0705.*

CHICAGO, IL The Chicago ARC will hold the Fall Ham Auction at the DeVry Inst. of Tech., 3300 N. Campbell, starting at 12 noon, until all is sold. Door opens at 10 AM for inspection of items.

NOV 20

BILLERICA, MA An Amateur Radio and Electronics Auction will be held from 11 AM-4 PM at Bull HN, 300 Concord Rd. Talk-in on 147.12. Seller Check-in at 9:30 AM. Item inspection at 10 AM. Sponsored by BULL HN 1200 RC and Waltham ARA. Contact *Eliot Mayer W1MJ, (508) 851-0183.*

HOLLAND, MI The 3rd annual Westshore Hamfest will be held by the Holland ARC, at Holland Christian H.S., 956 Ottawa Ave., from 8 AM-2PM. VE Exams. Make reservations early. Contact *Joe Campbell, (616) 772-4928 after 6 PM* or mail reservations to *Westshore Hamfest, c/o Joe Campbell, 10413 Northfield Dr., Holland MI 49424.* Talk-in on 147.06+

NOV 21

BENSON, NC The Johnston ARS, Inc., will hold its annual "Jarsfest" at the American Legion Complex from 8 AM-4 PM. Contact *Bill Lambert AK4H, 8917 NC 50 N., Benson NC 27504. Tel. (919) 894-3352 eves. 7 PM-10 PM.*

WASHINGTON, PA Washington Amateur Communications (W.A. COM) will hold its 6th annual Tri-State Hamfest/Computer Fair from 8 AM-3 PM, at Chartiers-Houston H.S. VE Exams. Talk-in on 145.49-W3CYO/R. Contact *Ted Lockman WB3BZK, (412) 222-6473; Russ Burhenn N3NEL, (412) 222-4037; or FAX (412) 258-8342.* Or write *W.A. COM, P.O. Box 1386, Washington PA 15301.*

NOV 27

EVANSVILLE, IN The ALL NEW Evansville Winter Hamfest, sponsored by EARS, will be held at the Vanderburgh County 4-H Center, Highway 41 (just north of Evansville). Doors open at 8 AM. Contact *Beverly Hensley KA9PDG, (812) 479-5741.* Talk-in on 145.150 in Evansville and 146.925 in Vincennes. Send reservations to *EARS, 1506 S. Parker Dr., Evansville IN 47714.*

NOV 28

WHEATON, IL IL-GMRS of Illinois, Inc. will hold their annual "Winterfest" from 8 AM-1 PM at the DuPage County Fairgrounds in Wheaton. Call *(708) 690-1492*; or write *GMRS, 2077 W. Roosevelt Rd., Wheaton IL 60187.*

DEC 4

NORTH OLMSTEAD, OH The North Coast ARC will hold their Fall Hamfest from 8 AM-2 PM at Saint Clarence Church, 30106 Lorain Rd. Electronics. Computers. Talk-in on 145.29 and 224.76 Rptrs. Contact *Dan Sarama KB8A, NCARC President, (216) 267-5083*; or *Rick Mace N8VKE, (216) 483-4818*; also, *NCARC Packet BBS NO8M.*

SPECIAL EVENT STATIONS

NOV 4

CLINTON, NC The Sampson County ARS will operate K4OAR from the Sampson County Expo., from 1700Z-2400Z; lower portion of the General bands. For a certificate, send QSL and SASE to *SCARS, P.O. Box 64, Clinton NC 28328.*

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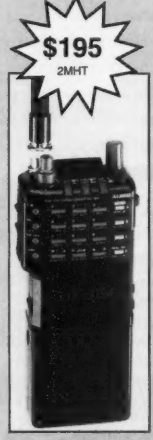
DJ-560T Dual Band HT

2M (Rx 130-174/Tx 144-148). 440 (Rx 400-520/Tx 440-450). 40 Memories + 2 call channels.Tone Encode and Decode.DTMF Encode and Decode. Paging & Scanning Functions. Auto Power Off

DJ-162TD 2 Meter HT

2M (Rx 137-174/Tx 144-148). 20 Memories + Call channel. DTMF Encode and Decode.Tone Encode (Decode W/EJ6U). Paging functions, Scanning, etc. Comes with AA Cell Battery case, see below for Nicad Packs/Chargers

$195 2M/HT



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NOV 6-7

BOLTON, VT The Central Vermont ARC will operate the Vermont Girl Scout Council SE Station W1BD from the Bolton Valley Resort, 1700Z Nov. 6th-0200Z Nov. 7th. Freq.: 14.233, 7.233, 3.865 MHz. For a Special Event QSL card, send QSL and SASE to *CVARC/VGSC Special Event, P.O. Box 674, Montpelier VT 05602-0674.*

NEW HAVEN, CT The South Central CT ARA will operate W1GB 1400Z-2300Z to commemorate the operation of the first telephone switchboard in the U.S. Operation will be in the General 40 and 20 meter subbands. For a certificate, send QSL and a 9" x 12" SASE to *Bruce Torello AA1BX, 494 Dogwood Rd., Orange CT 06477.*

NOV 6-11

GUELPH, ONT., CANADA SE Station VG3W will operate on 10, 15, 20, 40 and 80 meters as an "in memorium" for the fallen of both World Wars. Operation will be 10 AM-5 PM EST each day, with a minute of silence at the 11th hour of the 11th day of the 11th month. For a QSL card, send one IRC or Canadian Postage on SASE to *VG3W, c/o VE3ZM, P.O. Box 1305, Guelph, Ontario, Canada N1H 6N9.*

NOV 11-12

ALBUQUERQUE, NM The Albuquerque ARC will operate WB5MII from 1700Z Nov. 11th-1700Z Nov. 12th, to commemorate Veterans Day. The Station is located at the Veterans Administration Medical Bldg. For a certificate, please send a QSL and a 9" x 12" SASE to *AARC, P.O. Box 11853, Albuquerque NM 87192.*

NOV 13-14

CHARLOTTE, NC Mecklenburg ARS will operate W4BFB from 1400Z-2400Z Nov. 13th, and 1800Z-2400Z Nov. 14th, to celebrate the 2nd Anniversary of the amateur radio education center at Discovery Place, the hands-on science museum in uptown Charlotte. Operation will be in the lower 25 kHz of the General 80, 40, and 20 meter phone subbands; as well as in the Novice 10 meter phone subband. For a certificate, send a 9" x 12" SASE to *Mecklenburg ARS, 2425 Park Rd.-Room 023, Charlotte NC 28203-5974.*

COLLEGE PARK, MD The Laurel, MD ARC will operate W3DQI FROM 1700Z Nov. 13th-2100Z Nov. 14th, from College Park Airport. Operation will be in the lower portions of the General bands, near 28.5 in the Novice subband, and on 147.54 FM. For a certificate, send QSL, 9" x 12" SASE, and your QSO nr to *LARC, P.O. Box 3039, Laurel MD 20709-0039.*

STUART, FL Martin Co. Ares/Races will operate WA2TRJ 1400Z-2200Z both days, from the 6th annual Jensen Beach Pineapple Festival. Operation will be on the lower portion of the General 10, 15, and 20 meter bands. For a certificate, send QSL and a 9" x 12" SASE to *Larry Cohen WA2TRJ, 5595 SE Lamay Dr., Stuart FL 34997.*

NOV 19-21

FORT LANGLEY, B.C., CANADA The Frasier Valley ARA will operate VF7L from Fort Langley, to commemorate the 135th Anniversary of the Proclamation read by Sir James Douglas at Fort Langley, Nov. 19, 1858, creating the Colony of British Columbia. Operation will be on the 20, 15, and 10 meter bands in the General portions, from 1700Z to 2300Z over the 3 days. For a certificate, send QSL and a 9" x 12" SASE (or $1 to cover postage), to *Fraser Valley ARA, Box 50, Fort Langley, BC, V0X 1J0 Canada.*

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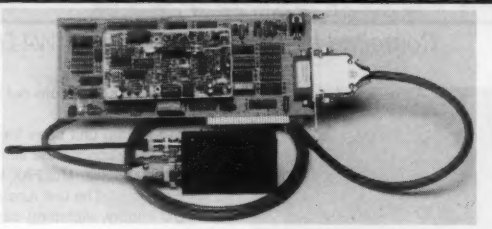

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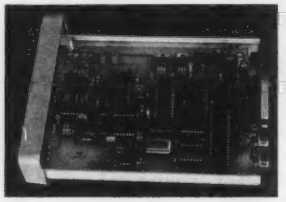
NEW PRODUCTS

Compiled by Charles Warrington WA1RZW



MULTIFAX

The new MultiFAX external WEFAX demodulator is now available, and it can be used anywhere with an IBM or compatible PC, Laptop, or Notebook. The unit interfaces directly through the parallel printer port; it does not require its own internal slot.

This external unit uses the same software and supports the same features as the popular MultiFAX Version 2.2 plug-in card. The unit runs on any 12 VDC supply, including cars and boats. Now you can downlink NOAA satellite weather imagery wherever you go.

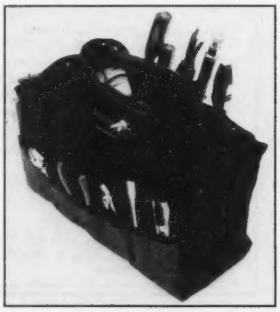
The price is $389 plus $8 S & H in the US. (The unit is shown with its cover removed.) For further information, contact: *MultiFAX 143 Rollin Irish Road, Milton VT 05468; (802) 893-7006, FAX (802) 893-6859.* Or circle Reader Service No. 202.

PAKTEK

PAKTEK has introduced the "Tool Tote" as their unique solution for the two biggest complaints about hard utility boxes: 1) They are clunky; and 2) They damage surfaces. The new-fashioned Tool Tote is strong but gentle.

This handy soft-sided utility organizer features an over-sized center compartment opening for easy access, 14 external pockets, an extra-large zipper with two pulls, bold red and black styling, and an affordable price of $24.97.

For more information or to place an order, contact: *PAKTEK, Inc., 7307 82nd St. Ct. SW, Tacoma WA 98498; (800) 258-8458.* Or circle Reader Service No. 201.

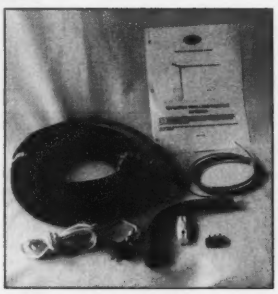


JADE PRODUCTS, INC.

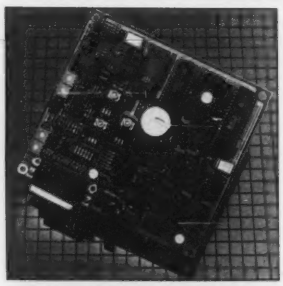
Here's the latest addion to Jade Products FUN-KIT line: the 160 Meter Twin-Lead Marconi Antenna. This antenna (Model AN-00001-01) is a complete, ready-to-install kit consisting of all the necessary hardware, wire, twin-lead, connectors, and support rope.

This antenna provides unique support for the twin-lead, thus preventing the failure due to fatigue and flexing which often occurs when hanging twin-lead by rope. This elbow support forms a gradual bend, and is adjustable. The antenna is approximately 126 feet long. With the elbow elevated to 35 feet, the horizontal section would require only 90 feet.

Installation and connection is simple; an antenna tuner is not required.



The price is $39.95. To order or for more information, contact *Jade Products Inc., P.O. Box 368, East Hampstead NH 03826; (603) 329-6995.* Or circle Reader Service No. 206.

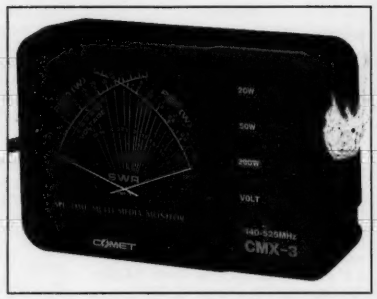


S-COM INDUSTRIES

S-COM Industries is now shipping a powerful 100-setpoint scheduler as a standard feature on all 5K Repeater Controllers. The scheduler executes user-defined macro commands at programmable setpoints (times and dates). The macro commands determine the action the controller will take, such as changing repeater access modes for day and night, and reprogramming the identifier for holidays and special events, etc. These can be set for a specific time and date, or for events recurring on a regular basis.

The controller automatically compensates for power outages and leap years. The 5K Repeater Controller is priced at $175. Options and upgrades for older models are available. For more information, contact: *S-COM Industries, P.O. Box 1718, Loveland CO 80539-1718; (303) 663-6000.* Or circle Reader Service No. 206.

NCG COMET



New from Comet, this compact Cross Needle SWR/Power Meter has its metering separate from its RF sensor. Three models are available for high power HF, low power HF/VHF, and low power VHF/UHF. The Cross Needle design provides forward and reflected power and VSWR simultaneously.

Three-switch selectable power ranges are provided on each model, with a fourth switch to measure DC voltage from the power supply or vehicle. The meter is lighted in color for easy reading.

The CMX Meter Series is specifically designed and ideally suited to mobile operation. Each meter comes with a standard six-foot cable allowing placement of the meter head near the rig's remote head, while the sensor is near the rig itself. An optional 10-foot extension is also available.

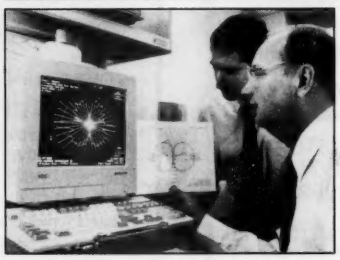
The CMX Series is available from your amateur radio dealer. For more information contact: *NCG Company, 1275 North Grove St., Anaheim CA 92806; (800) 962-2611, FAX (714) 630-7024.* Or circle Reader Service No. 204.

P.C. ELECTRONICS

Here's a low-cost progressive way of getting into ATV: the P.C. Electronics Model TX70-1b 1.5 watt 70 cm (420-450 MHz) Transmitter. Many start by purchasing the $89 TVC-4G Tunable Down Converter just to check out the local ATV repeater or simplex action. After the ATV bug bites, they are ready to transmit back. But now, instead of trading for an all-in-one-box transceiver, they can just add the companion TX70-1b Transmitter for $279.

The transmitter's rugged die-cast aluminum cabinet weighs less than two pounds and is small enough to easily fit in a knapsack. The unit comes with one crystal but has provisions for switching between two frequencies. The external power requirements are 12 to 14 VDC at 500 mA. The antenna connector is a type N; a BNC outputs to the receiving down converter from the built-in RF and power T/R relay.

No-code Technician Class or higher amateurs are welcome to write or call for a 10-page catalog. Please contact: *P.C. Electronics, 2522 Paxson Lane, Arcadia CA 91007; (818) 447-4565.* Or circle Reader Service No. 205.



ANTENNA SPECIALISTS

The Antenna Specialists Co. has developed a new set of software programs to aid communication system designers and operators in producing critical base antenna calculations and patterns tailored to their own system requirements. Called the RF Tools Series, the programs are said to be both highly accurate and easy to use.

Disk 1, called DXPLOT, permits precise calculation of beamtilt coverage. Disk 2, called PATPLOT, displays and plots digitized base antenna patterns. Disk 3, called ANTPLOT, develops patterns for side-mounted base antennas. These programs are available on 5-1/4"" IBM compatible disks, but the programs can also be downloaded, free of charge, from the manufacturer's remote bulletin board system (RBBS). The A/S RBBS is online 24 hours a day and offers an enormous bank of technical and product information, files capability, tutor and help utilities, and listings of technical and engineering support staff. The modem communications format is 300/1200/2400/9600-N81. The number is (216) 349-8698.

For further information contact: *The Antenna Specialists Company, 30500 Bruce Industrial Parkway, Cleveland OH 44139-3996; voice (216) 349-8400, Fax: (216) 349-8407.* Or circle Reader Service No. 203.

Number 23 on your Feedback card

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The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, Judy Walker, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the December classified ad section is October 14, 1993.

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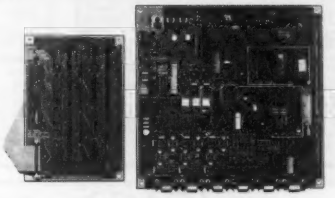

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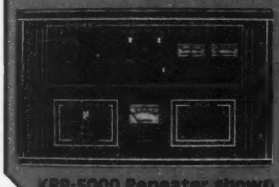

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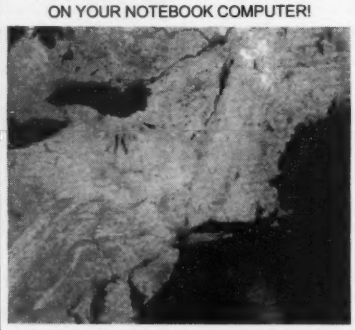

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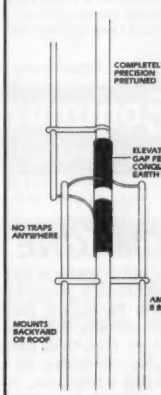

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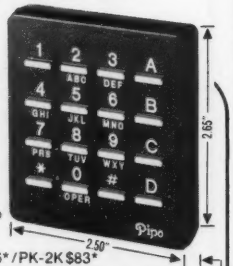

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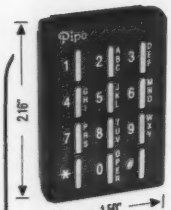

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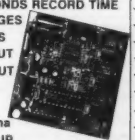

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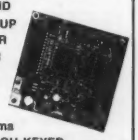

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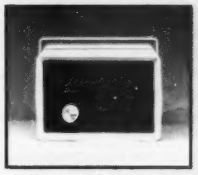

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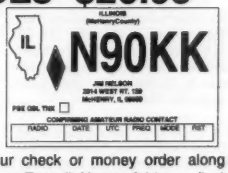

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RANDOM OUTPUT

David Cassidy N1GPH

Giving Thanks

It is approaching that time of the year when we are supposed to reflect upon our lives, and ponder the things for which we should give thanks. When I sit down to that Thanksgiving meal, here are some of the things that I'll be giving thanks for.

First and foremost, thanks to Wayne Green for his continued trust, guidance and example. I have learned more about marketing and publishing in the last three years than I did in the previous 10. We don't just talk about things here at WGI, we *do* them. It is Wayne's leadership that fosters this type of entrepreneurial spirit, and makes it a pleasure to come to work in the morning.

I also need to thank the staff of *73*. Less than a dozen people put out this magazine (as well as *Radio Fun)*, and I can honestly tell you that I have never worked with a more talented group of people (and I've been lucky to have worked with some pretty talented folks). We are truly a team, and I think it shows in the quality of our magazine. I hope you agree.

Thanks to the companies who advertise with us. I have never worked in an industry where I consider so many business associates friends. We've had quite a few advertising success stories over the last few years, and I'm happy that more and more companies are waking up to the fact that *73* readers are their biggest source of potential customers.

Thanks to the 30,000 (and growing) of you who send us your $20 every year to subscribe. It is for you that we fight deadlines, scrutinize every word, draw figures, paste up ads . . . and then do it all over again 30 days later. Your letters tell us that you appreciate our efforts, and you let us know when we've fallen short of our own high standards. More thanks to the over 20,000 (and growing) of you who plunk down your $2.95 every month to buy *73* on the newsstand.

admit it, but the no-code license has single-handedly kept the amateur radio industry from feeling the worst of the economic difficulties of the last few years. The no-coders have also revitalized many ham clubs across the country. Contrary to what the Techbashers have been crying, those who have entered our ranks via the Technician Class license *are* learning the code and upgrading at a phenomenal rate. Take a good, hard look folks, because this is the future of amateur radio.

"Lots of people won't admit it, but the no-code license has single-handedly kept the amateur radio industry from feeling the worst of the economic difficulties of the last few years."

Thank you to the columnists and writers who grace us each month with their talents. I am continuously amazed at how good our writers are! I truly believe that *73* has the finest group of columnists and regular contributors of any magazine in the electronics field. If you doubt me, go ahead and do a side-by-side comparison with any other magazine. It ain't bragging when it's true.

Thank you to the ARRL. Yup . . . I said the ARRL. Regular readers of this column might be asking themselves, "Why is Dave thanking the organization that he spends so much time criticizing?" First of all, I am *not* anti-ARRL. I believe that the League is the only organization that is capable of representing the interests and ensuring the future of amateur radio. I just wish they would do it! I'd like to thank the gang in Newington for providing me with so much material over the last few years. We can only hope the day will come when this will no longer be the case.

We should all thank the FCC for the new Technician Class license. While we're at it, let's send a hearty "thanks" to all of the Techs (and all the other newcomers) who have received their licenses his year. Lots of people won't

Thanks to those of you who take the time to stop by the *73* booth at hamfests. You have no idea how helpful it is to have face-to-face discussions with our readers . . . and our non-readers. You remind us that, more than most magazines, the relationship we have with our readers is a phenomenon in the publishing industry. That goes double for *Radio Fun* readers. It is a relationship that we here at the home office truly cherish and strive to live up to.

Finally, thanks to all of you who read "Random Output," especially those who choose to write and comment on my monthly musings (even those who think I should shut up and stop bothering people). Your opinions are of vital importance, and it helps immeasurably to know what you are thinking. A magazine column is so often a monologue. You folks make it more of a dialogue, and that makes all the difference. 73

Number 25 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

You can expect November conditions to be generally Fair (F) to Good (G) this month, *except for the week between the 16th and 23rd when conditions are expected to be Poor (P) to Very Poor (VP), particularly on the 18th and 22nd.* During this week there may be geophysical disturbances in the atmosphere as well as the ionosphere, so be aware of possible heavy storms of rain or snow and other effects such as volcanism, earthquakes, and the like somewhere on earth. Pay particular attention to your local radio and TV stations during this week with announcements of local weather conditions.

November is a month when propagation is trending from the generally good DX outlook of September and October to the generally poorer DX conditions of November, December, and January. The higher frequency bands *above* 20 meters are likely to close early (at sunset or shortly thereafter), and the lower frequency bands *below* 20 meters will be open after dark and until the early morning hours. Except for the days on the chart marked Poor or Very Poor, you will find the low atmospheric noise and the wide-open 160, 80, 40, and 30 meter bands to be a big change from summer and fall.

As you know, the sunspot numbers are declining each month, with only an occasional spurt of solar flux above the 100 level. The sunspot minimum is now predicted for sometime in late 1996 or early 1997 . . . with a good possibility that an even earlier minimum may occur. During these times of sunspot *inactivity* there will be *fewer* openings for DX on the HF bands. Keep an ear open for DX to Europe in the morning hours local time, and to the Pacific in afternoon hours on the 10, 12, 15, and 17 meter bands. Midday openings to South and Central America and Africa may be possible on some days this month. Short skip within the U.S. will prevail on Good (G) days. The 20 meter band will be the mainstay DX band this month, with occasional surprises on the higher bands. Twenty will show openings to all parts of the world on Good (G) days until well after dark.

The 40 and 80 meter bands (and 30 meters, too) will be very good for DX into Europe in the evening hours, and to the Pacific during the early morning hours around sunrise. Eighty meters may well be the choice of DXers for the next couple of months, so make sure your antennas for these bands are up and running at optimum performance.

On 160 meters, there will be little activity until around sunset and after, throughout the evening hours and peaking toward Europe around midnight. Openings to the Pacific and the south and west will be best around sunrise. You will enjoy very low atmospheric noise and strong signals. See you next month! 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15*	20	20	20	–	–	–	–	–	–	–	15*
AGENTINA	15	15	20	20	40	–	–	10	–	–	10	10
AUSTRALIA	10	15	20	20	–	40	20	20	–	–	–	10
CANAL ZONE	15	40*	40*	40*	40*	–	20	10	10	10	10	10
ENGLAND	20	40	40	40	–	–	20	10	10	10	15	20
HAWAII	10	15	20	20	40*	40	20	20	–	–	–	10
INDIA	20	20	–	–	–	–	–	15	–	–	–	–
JAPAN	15*	20	20	20	–	–	–	–	–	–	–	15*
MEXICO	15	40*	40*	40*	40*	–	20	10	10	10	10	10
PHILIPPINES	–	–	20	20	–	–	20	15*	15*	–	–	–
PUERTO RICO	15	40*	40*	40*	40*	–	20	10	10	10	10	10
SOUTH AFRICA	40*	20	20	20	–	–	–	–	10	10	10	15
U.S.S.R.	–	40	20	20	20	–	–	10	10	15	20	20
WESTCOAST	10	15	20	20	80/40	80/40	–	–	–	10	10	10

CENTRAL UNITED STATES TO:

ALASKA	10	15	20	20	20	–	–	–	–	–	–	–
ARGENTINA	15	15	20	20	20	–	–	10	–	–	10	10
AUSTRALIA	10	15	15	20	20	40*	40	20	–	–	15	10
CANAL ZONE	15	15	20	20	–	40	40	10	10	10	10	10
ENGLAND	–	–	–	–	–	–	10	10	15	15	20	20
HAWAII	15	15	20	20	40*	40*	40	20	–	–	10	10
INDIA	–	20	–	–	–	–	–	20*	15	–	–	–
JAPAN	10	15	20	20	20	–	–	–	–	–	–	–
MEXICO	15	15	20	20	–	40	40	10	10	10	10	10
PHILIPPINES	15	–	–	–	–	–	–	20	10	10	–	–
PUERTO RICO	15	15	20	20	–	40	40	10	10	10	10	10
SOUTH AFRICA	20	20	20	–	–	–	–	–	10	10	15*	15
U.S.S.R.	–	–	20	–	–	–	20	15	15	15	20	20

WESTERN UNITED STATES TO:

ALASKA	10	15*	–	20	20	20	20	20	20	20	–	15
ARGENTINA	10	15	15	20	20	20	–	–	10	–	10	10
AUSTRALIA	10	15*	15*	20*	20	20	40	–	–	–	–	10
CANAL ZONE	10	15	15	40/20	40/20	–	–	–	15*	10	10	10
ENGLAND	–	–	–	–	–	–	–	–	15	20	15	–
HAWAII	10	10	15	20	40*	40*	40	40	15	15	–	15
INDIA	–	20/15(1)	–	–	–	–	–	–	20/15(1)	15(1)	–	–
JAPAN	10	15*	–	20	20	20	20	20	20	20	–	15
MEXICO	10	15	15	40/20	40/20	–	–	–	15*	10	10	10
PHILIPPINES	10	10	–	–	–	–	–	–	20*	15	15	–
PUERTO RICO	10	15	15	40/20	40/20	–	–	–	15*	10	10	10
SOUTH AFRICA	20	20	–	20	–	–	–	–	–	10	15	15
U.S.S.R.	–	–	–	20	20	–	–	–	15	15	20	20
EAST COAST	10	15	20	20	80/40	80/40	–	–	–	10	10	10

*Try next higher band (1) Difficult patch

NOVEMBER 1993

SUN	MON	TUE	WED	THU	FRI	SAT
	1 G	2 G-F	3 F	4 F	5 F	6 F
7 F-G	8 G	9 G	10 G-F	11 F-G	12 G	13 G
14 G	15 G-F	16 F-P	17 P	18 VP	19 P-F	20 F-P
21 P	22 VP	23 P	24 P-F	25 F	26 F-G	27 G
28 G-F	29 F	30 F-G				

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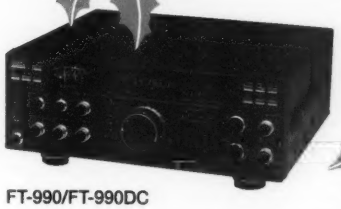

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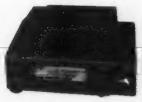

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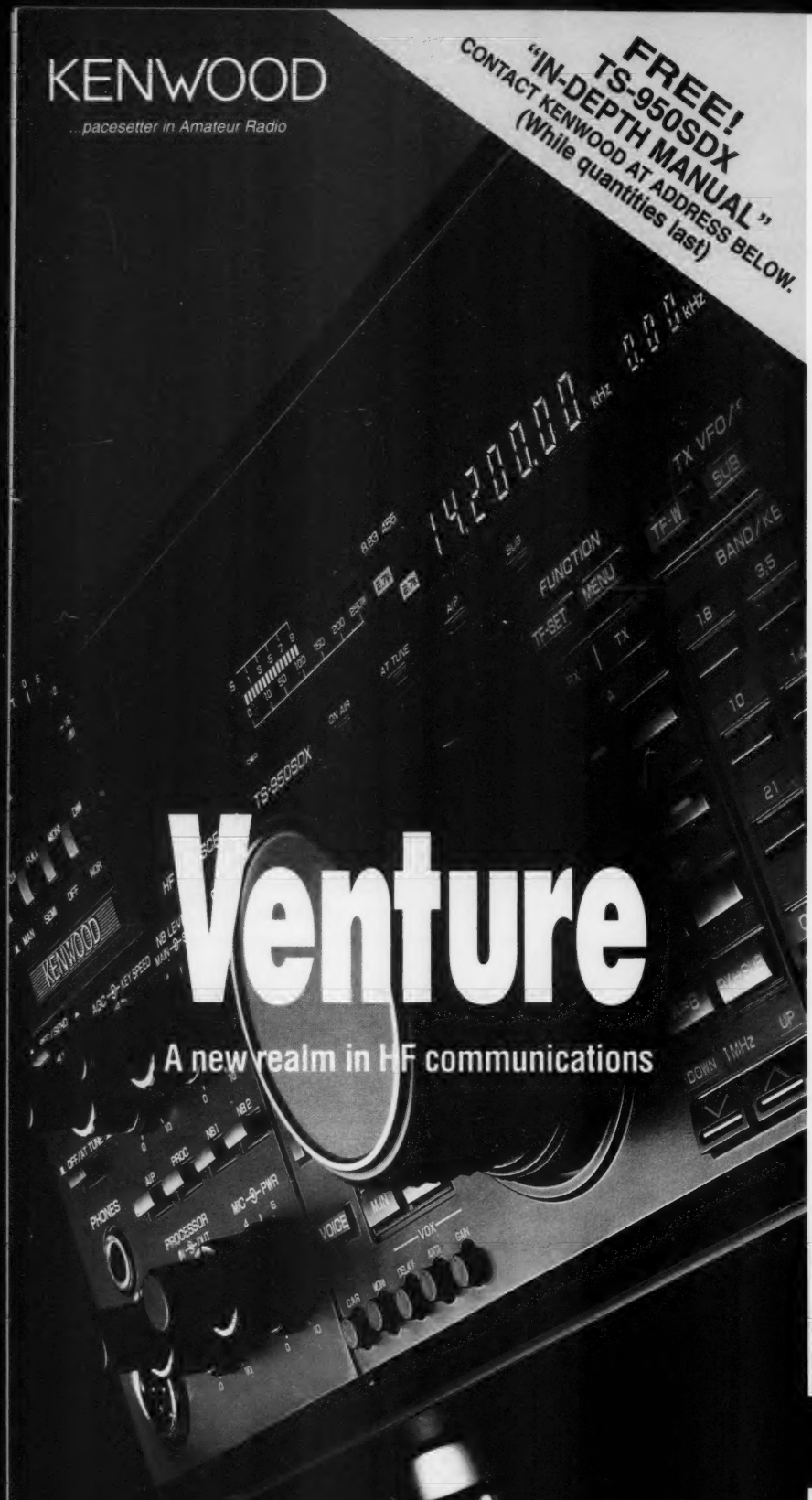

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